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PETROLEUM ASSOCIATION FOR CONSERVATION OF THE CANADIAN ENVIRONMENT
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PACE Report No. 86-2

WASTE MANAGEMENT GUIDELINES FOR PETROLEUM REFINERIES AND UPGRADERS

"Working for a Better Environment"

WASTE MANAGEMENT GUIDELINES FOR PETROLEUM REFINERIES AND UPGRADERS

PACE REPORT NO. 86-2

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DISCLAIMER

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FOREWARD

The purpose of this manual is simply to provide guidance to people in charge of handling waste streams in petroleum refineries and upgrader plants. It provides them with a mechanism for determining if their waste is hazardous or not and informs them as to what constitutes good industrial practice when dealing with the handling, storage, transport, treatment and disposal of such wastes. It resulted largely from the need to have a practical, "down-to-earth" working guide for industry personnel responsible for dealing with the increasingly complex technical and legal aspects of waste management.

It is not a static document but one that will continue to undergo revisions as new information regarding specific wastes becomes available or new legislative rules are introduced. The looseleaf format allows for updating sections or pages of the manual from time to time, as required.

Throughout this manual the term "petroleum plant" is used synonymously with refinery or heavy oil upgrader plant. In addition, the importance of precise definitions cannot be over-stressed when dealing with a subject as broad as "waste management", where over the years a rather loose vernacular has evolved as demonstrated by such terms as "landfill" and "open dumping". For differentiating between a "waste" and a "hazardous waste", the definitions developed through a consensus process by a federal task force were adopted, namely,

> Waste: "Any material for which the owner/generator has no further use and which he discards."
>
> Hazardous Waste: "Wastes which due to their nature and quantity are potentially hazardous to human health and/or the environment and which require special disposal techniques to eliminate or reduce the hazard."

Other definitions and abbreviations used throughout the manual are contained in the Glossary contained in Part C, Appendix 1.

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EXECUTIVE SUMMARY

It is generally recognized today that the safe disposal of both industrial and municipal wastes is one of the more serious environmental issues facing our society. In the face of this challenge, the petroleum industry in Canada has accepted its responsibility for managing its waste from "cradle to grave", and in that proactive spirit has commissioned this manual.

The purpose of this "guideline" document is to provide general direction to petroleum plants as to what constitutes good operating practice in dealing with the handling, storage, transport, treatment and disposal of their waste materials.

It provides a mechanism for answering the key questions - "Is this waste hazardous, and if so, how should it be treated or disposed of?"

SCOPE

The manual is divided into three distinct parts, namely A, B, and C.

PART A is a compendium of easy to use Waste Data Sheets (WDS), each sheet containing relevant information specific to a given waste. Each Waste Data Sheet also contains a guideline indicating the preferred options for treatment and disposal for that specific waste.

PART B is a narrative section of the manual designed to assist the user by providing background information on the nature of the waste management problem, current industry practices, transportation of wastes, legislation, treatment and disposal technology.

PART C contains seven Appendices where more detailed information can be found. The range of subjects covered includes a glossary of terms, summary of legislation, a compendium of licensed and approved hazardous waste treatment and disposal facilities, testing and monitoring protocols, and a bibliography.

WASTE MANAGEMENT PROGRAM

Good waste management requires planning built on a foundation of a rational philosophic framework. As a fundamental principle the first goal of waste management is to reduce the quantity of waste to an absolute minimum. This can be accomplished through the application of what has become known as the four "R's", i.e. Reduction, Reuse, Recycling and Recovery. Only after these four approaches to waste management have been considered should the residual material be subjected to more sophisticated treatment and final disposal. In any waste management program it is important that each plant carry out an inventory of its wastes and identify their chemical composition. Then the plant should classify the wastes according to their degree of hazard and address such options as exchanging waste streams with other industry sectors that may find valuable components in the wastes originating from petroleum plants.

INDUSTRY SURVEY

As part of the data base for this manual, a survey of waste management practices was conducted of the Canadian petroleum refining and upgrading plants in 1985. Over 50 different waste streams were reported. Five of these wastes are listed as hazardous by the U.S. Environmental Protection Agency and in Canada by the Federal and a number of Provincial governments. The percentage of Canadian petroleum plants generating these "listed" wastes are as follows:

Hazardous Waste	Plants Surveyed Generating Waste Percent
(1) Gravity Separator Sludge	93
(2) Leaded Tank Bottom Sludge	67
(3) Air Flotation Sludge	41
(4) Heat Exchanger Cleanings	25
(5) Slop Oil Emulsion Solids	15

It should be noted that since the above wastes are listed in legislation they are automatically considered to be hazardous by law. Other wastes that are not on any proscribed list may still fall into the hazardous category when evaluated against legislated criteria, such as the leachate toxicity test. Only a review of the chemical and toxicological data can provide the necessary information to assess the degree of hazard of such waste streams.

The survey included wastes from the heavy oil upgrading operation of an oil sands processing plant. The mining and extraction sections of these operations were not within the scope of this study. The results however showed that wastes from the upgrader did not differ materially from conventional refineries.

A summary of current treatment and disposal practices showed that:

1. The industry employs recycling and reuse to a significant degree.

2. Petroleum plants still depend on landfill for the disposal of the majority of their wastes,

3. Most plants practice some form of on-site land treatment of their oily and/or biological sludges. Heavy oil wastes from upgraders, because of high molecular weight components such as asphaltenes, do not biodegrade on land. These wastes are

usefully employed in combination with sand and gravel as road surfacing materials in remote areas.

4. There were little differences between the refinery waste streams and those from the upgrader plant surveyed.

LEGISLATION

Environmental legislation has been enacted in Canada to deal with the handling, storage, treatment and disposal of municipal and industrial wastes. The federal government generally has only indirect control in the legislation of industrial waste with the exception of wastes generated by crown corporations and interprovincial or international movements of wastes. The provinces, however, play a stronger role in regulating wastes and in some instances have passed down jurisdictional authority to municipal governments for this area.

Under the federal Transportation of Dangerous Goods Regulations, certain petroleum plant wastes have been listed as dangerous. In addition, there are requirements for tracking wastes shipped through a manifest system that involves the generator, the carrier, and the disposal plant operator. This allows government to track hazardous wastes from "cradle to grave."

"Decision trees" have either been developed or are in the process of being developed by government agencies, for the systematic evaluation of waste streams in terms of complying with the classification, registration, labelling, placarding and manifesting requirements. It is most important that petroleum plant personnel become fully acquainted with their specific local legislative requirements in order to comply with the law. Penalties for non-compliance are severe, including heavy fines and prison sentences.

TREATMENT AND DISPOSAL TECHNOLOGY

The technology used in the treatment and disposal of petroleum plant wastes includes land treatment of certain organic waste, incineration, landfill (secure and non-secure), detoxification, chemical solidification or fixation. However, new and more sophisticated technologies, for example those used in the destruction of refractory organics, are under active development and many will soon be available commercially. It is important that the petroleum industry encourage these developments and continue to maintain an up to date knowledge base on this important subject.

CONCLUSION

With increasing population, the magnitude of Canada's overall waste management challenge continues to grow. The petroleum industry, through PACE, has historically promoted research, worked to upgrade industry environmental practice and assisted government in developing effective legislation for environmental preservation.

It is hoped that this Waste Management Guideline Manual will contribute to the promotion of improved waste management practices in the industry. It will be particularly useful in assisting plant management by serving as a foundation on which to build their own individual comprehensive waste management program.

PART A

WASTE MANAGEMENT GUIDELINES

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WASTE DATA SHEETS

I - Storage and Handling
II - Process Units
III - Utility Plant
IV - Waste Water Treatment Plant
V - Miscellaneous
  - Maintenance
  - Laboratory
  - Administrative Building

WASTE MANAGEMENT GUIDELINES

INTRODUCTION

Part A is specifically designed to provide the user with easy access to a great deal of information, in a tightly structured condensed format, for each petroleum plant waste.

A separate waste data sheet is included for each of the fifty plus waste streams identified in the industry survey. An index, grouping wastes according to plant source, identifies the location of each waste data sheet by a two part numerical code. The first part (Roman Numeral) identifies the source category, e.g. utility plant, and the second number (Arabic) identifies the listing position. This system allows for future revisions and additions.

Each data sheet is organized into seven sections. The first three sections define the properties of the waste. Sections 4, 5 and 6 are guidelines on handling and storage, transport, treatment and disposal. Section 6, perhaps the section of greatest interest, identifies the acceptable and non-recommended disposal practices. Relevant environmental references are also outlined in each data sheet. General safety and hygiene references are outlined on page A-4.

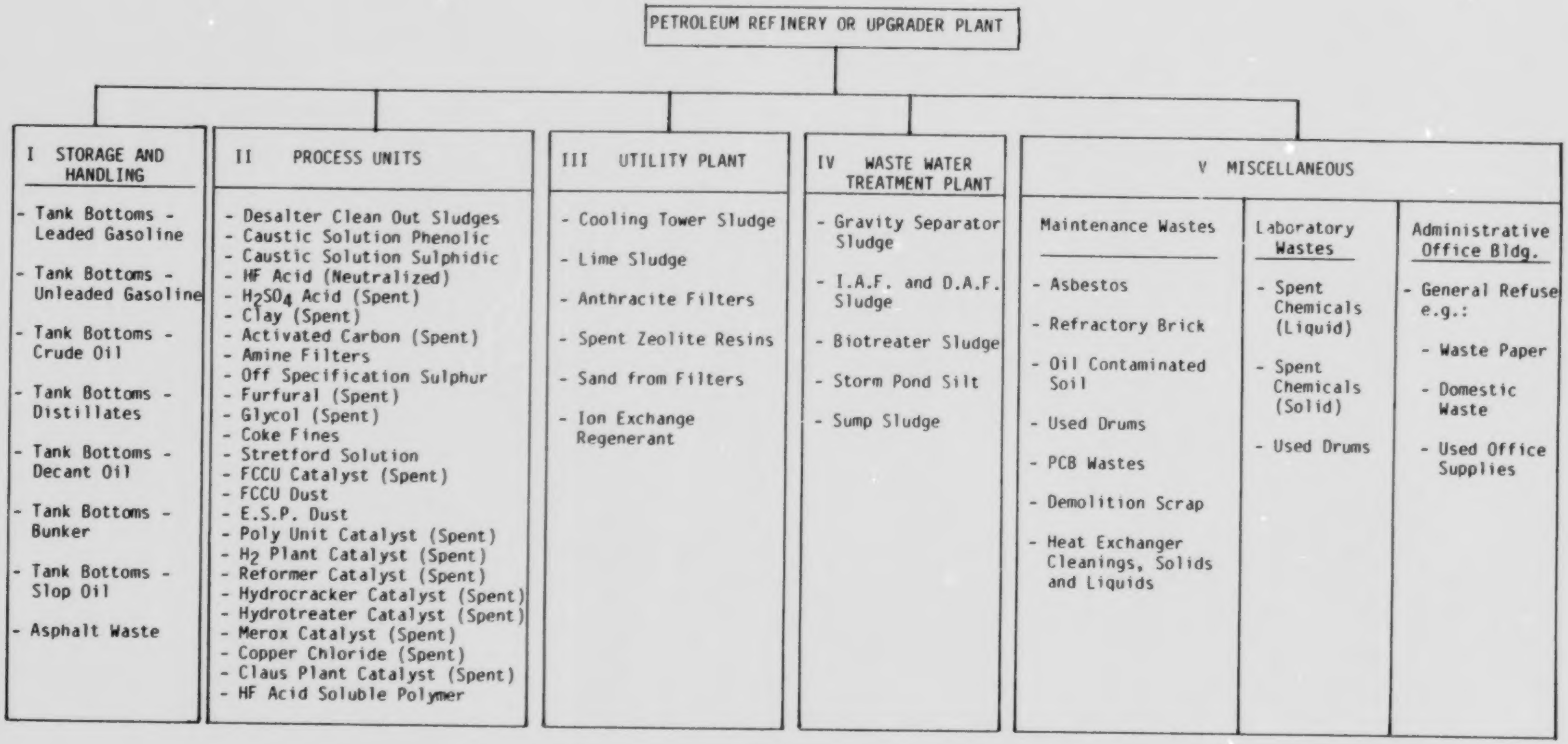
Care must be exercised in using these sheets to avoid over simplistic interpretations of the guidelines when applied to disposal situations. As an example, in the land treatment of oily sludges the soil receptor and ground water levels are important factors that must be examined. The ultimate use of the land, the soil's chemical and physical characteristics, cation exchange capacity, and water table are considerations that are as important as defining the chemical properties of the oily sludge. A land treatment operation is a controlled process that must be properly engineered, considering all the variables, in order to provide the degree of environmental protection required.

Figure 1 is a schematic block diagram showing the various plant waste streams and the major source categories from where they originate.

A specific index for each waste category is provided for convenience as each category section is separated by convenient index tabs to facilitate waste data sheet location.

When the "Waste Data Sheets" are updated, the date of revision and revision number will be clearly indicated in the top right hand corner of each sheet. In addition spare blank data sheets have been included at the end of this section for those plants who may wish to prepare their own data sheets for their special wastes.

FIGURE 1 - SOURCES OF PLANT WASTE



PETROLEUM REFINERY OR UPGRADER PLANT

I STORAGE AND HANDLING

- Tank Bottoms - Leaded Gasoline
- Tank Bottoms - Unleaded Gasoline
- Tank Bottoms - Crude Oil
- Tank Bottoms - Distillates
- Tank Bottoms - Decant Oil
- Tank Bottoms - Bunker
- Tank Bottoms - Slop Oil
- Asphalt Waste

II PROCESS UNITS

- Desalter Clean Out Sludges
- Caustic Solution Phenolic
- Caustic Solution Sulphidic
- HF Acid (Neutralized)
- H_2SO_4 Acid (Spent)
- Clay (Spent)
- Activated Carbon (Spent)
- Amine Filters
- Off Specification Sulphur
- Furfural (Spent)
- Glycol (Spent)
- Coke Fines
- Stretford Solution
- FCCU Catalyst (Spent)
- FCCU Dust
- E.S.P. Dust
- Poly Unit Catalyst (Spent)
- H_2 Plant Catalyst (Spent)
- Reformer Catalyst (Spent)
- Hydrocracker Catalyst (Spent)
- Hydrotreater Catalyst (Spent)
- Merox Catalyst (Spent)
- Copper Chloride (Spent)
- Claus Plant Catalyst (Spent)
- HF Acid Soluble Polymer

III UTILITY PLANT

- Cooling Tower Sludge
- Lime Sludge
- Anthracite Filters
- Spent Zeolite Resins
- Sand from Filters
- Ion Exchange Regenerant

IV WASTE WATER TREATMENT PLANT

- Gravity Separator Sludge
- I.A.F. and D.A.F. Sludge
- Biotreater Sludge
- Storm Pond Silt
- Sump Sludge

V MISCELLANEOUS

Maintenance Wastes

- Asbestos
- Refractory Brick
- Oil Contaminated Soil
- Used Drums
- PCB Wastes
- Demolition Scrap
- Heat Exchanger Cleanings, Solids and Liquids

Laboratory Wastes

- Spent Chemicals (Liquid)
- Spent Chemicals (Solid)
- Used Drums

Administrative Office Bldg.

- General Refuse e.g.:
  - Waste Paper
  - Domestic Waste
  - Used Office Supplies

TABLE 1

WASTE SOURCE CODE

CODE	WASTE SOURCE
I	STORAGE AND HANDLING
II	PROCESS UNITS
III	UTILITY PLANT
IV	WASTE WATER TREATMENT PLANT
V	MISCELLANEOUS - Maintenance - Laboratory - Administrative Building

NOTE: This Table shows the Code used to identify the source of the waste in the petroleum plant. Each Waste Disposal Sheet (WDS) is given a number made up of the source code (Roman Numeral) and numeric digit(s) (Arabic), e.g. WDS I-4 refers to distillate tank bottoms, a waste that originates from storage and handling.

REFERENCES FOR SAFETY AND HYGIENE PORTIONS OF WASTE DATA SHEETS

"Guidelines for the Selection of Chemical Protective Clothing". Published by the ACGIH (American Conference of Governmental Industrial Hygienists), 1985.

"Chemical Protective Clothing Guidelines". These recent guidelines were developed by the Industrial Hygiene Exposure Assessment and Control Group of the API Health and Environmental Science Departments.

"Heating and Cooling of Man in Industry". Published by the AIHA (American Industrial Hygiene Association).

"Industrial Eye and Facial Protection". A CSA (Canadian Standards Association) Z94.3 - M1982 standard.

"Respiratory Selection". A CSA Z94.4 - M1982 standard. Other suitable ANSI (American National Standards Institute) standards may also be used.

"Compressed Breathing Air Standard". CAN-3-Z180.1 - M1985, developed by CSA.

"Confined Space Entry". Publication No. B-01-228 available from IAPA, Toronto.

PART A

WASTE DATA SHEET (WDS) INDEX

CODE I - STORAGE AND HANDLING WASTES

WDS NO.	NAME OF WASTE	SYNONYM	DATE ISSUED/ REVISED
I-1	Leaded Gasoline Tank Bottoms	Leaded Sludge	November 1986
I-2	Unleaded Gasoline Tank Bottoms	Gasoline Tank Bottoms	November 1986
I-3	Crude Oil Tank Bottoms	Crude Tank Bottoms	November 1986
I-4	Distillate Tank Bottoms		November 1986
I-5	Decant Oil Tank Bottoms	Catalytic Fractionation Bottoms	November 1986
I-6	Bunker Oil Tank Bottoms		November 1986
I-7	Slop Oil Tank Bottoms		November 1986
I-8	Asphalt Waste		November 1986

PACE

WASTE DATA SHEET

NAME OF WASTE: LEADED GASOLINE TANK BOTTOMS

(SYNONYM)

SHEET NO. I-1

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Storage and Handling

GENERAL DESCRIPTION: Over a period of years, leaded gasoline tanks accumulate liquids and solids in the bottom. If the tank is to be entered for repairs or serviced internally, these wastes must be removed.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: 0.9 - 0.96

SOLUBILITY IN WATER: Extremely low

APPEARANCE: Dull gray/black colour

ODOUR: Characteristic gasoline type

CHEMICAL DATA: API reports the composition as:

	Average
Water	37.9%
Solids	59.0%
Oil	8.5%

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

- Organic lead compounds and various other heavy metals - TML, TEL, Mn compounds, Organic dyes, Anti-icing compounds, phenols, benz(a)pyrene. API reports that the sludge consists of insoluble deposits wetted by water and hydrocarbons containing organic lead. The sludge will contain .04Kg to .18Kg (.1 to .4Lbs) of organic lead per ton of sludge.

POTENTIAL HAZARDS: Of the 27 samples of leaded sludge tested, 26% failed the EP Toxicity Test, 29% the Ignitability Test, 14% the Reactivity Test and none the Corrosivity Test. U.S. EPA has identified leaded tank bottoms as one of the 5 "listed" wastes from petroleum plants. For additional hazards, see comments on data sheet I-2.

PERSONAL PROTECTION:

- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment is decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- May be stored in steel tanks.
- Vapour control is necessary.
- Treat waste as if it were gasoline.

HANDLING PRECAUTIONS:

- In confined spaces specific procedures must be followed. Use explosive-proof mechanical ventilation equipment.
- Due to the presence of organic lead there is a potential for fire or explosion and detailed API procedures must be followed during any storage tank cleaning.
- Prevent leaching of this waste sludge or the decontamination "washings" into the subsurface waters.
- This volatile material will pose a fire hazard.

NAME OF WASTE: LEADED GASOLINE TANK BOTTOMS **WASTE DATA SHEET NO.** I-1

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): 9374 **TDGR CLASSIFICATION:** 6.1

TYPE OF CARRIER: Provincially licensed closed tank vehicle.

WAYBILLS REQUIRED: TDGA Provincial or Federal Manifest.

LOADING/UNLOADING PRECAUTIONS: Since the volume of leaded sludge is generally small, hand tools such as shovels, brooms, scrapers, buckets, rags, etc. are generally used for cleaning purposes. Care should be taken to ensure that all electrical equipment is explosion proof and suitable for a hydrocarbon atmosphere.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: Finished gasoline is composed of several base stocks and a number of additives such as tetraethyl lead, manganese compounds, gum inhibitors, detergents, anti-icing compounds, dyes, etc. During the blending process it is possible for liquids in the bottom of the component tanks to be carried over into the finished storage tank. This carryover may consist of water, caustic streams, Merox catalyst and inhibitors containing derivatives of phenol and cresol injected into the rundown stream. The sludge will also contain some scale and rust from the inside of the storage tank. The current survey shows that 11% of the leaded sludge is being landfarmed, 78% landfilled and the remaining 11% goes to an outside disposal contractor. Where permitted by law, sludge may be treated by weathering. This process changes the organic lead (highly toxic) to the inorganic form. The sludge is spread to a depth of 8 cm. (3 inches) or less on an impervious surface such as concrete or clay and allowed to weather. If the temperature is above 0°C (32°F) this will take, at best, only four weeks, but a longer period is desirable.

DISPOSAL GUIDELINE:

Acceptable:
- Weathering of sludge, followed by Secure landfill
- Chemical fixation

Not Recommended:
- Incineration
- Burying in drums
- Non-controlled tank farm spreading
- Raw sludge to sanitary landfill

SECTION 7 - SELECTED REFERENCES

1. American Petroleum Institute "1982 Refinery Solid Wastes Survey" by Environmental Resources Management Inc., West Chester, Pennsylvania, U.S.A. (zip code 19380).
2. American Petroleum Institute Publication 2015A "Guide for Controlling the Lead Hazard Associated with Tank Entry and Cleaning", June 1982.
3. PACE Report No. 80-4 "Canadian Petroleum Refining Industry Waste Survey", October 1980.
4. American Petroleum Institute Publication 2015 "Cleaning of Petroleum Storage Tanks.

NOTE: This Waste Data Sheet is based on the best available information at time of publication. If additional pertinent information becomes available to the reader, we would appreciate having it brought to our attention at the following address: PACE, 1202-275 Slater Street, OTTAWA, Ont. K1P 5H9 - Attn.: Tech. Coord. Your input will be considered for inclusion at the time of the next revision.

While PACE and its consultant believe that the data contained herein are factual and the opinions expressed are those of qualified experts, the data are not to be taken as a warranty or representation for which PACE or its consultant assumes legal responsibility. Any use of these data and information must be determined by the user to be in accordance with applicable federal, provincial and local laws and regulations.

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WASTE DATA SHEET

NAME OF WASTE: UNLEADED GASOLINE TANK BOTTOMS

(SYNONYM)

SHEET NO. I-2

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: STORAGE AND HANDLING

GENERAL DESCRIPTION:

Unleaded gasoline tanks accumulate a layer of water and solids in the bottom after a number of years of use. These wastes must be removed when the tank is to be entered for repairs or servicing internally.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: 0.72 - 0.85

SOLUBILITY IN WATER: Extremely low.

APPEARANCE: Gray/black

ODOUR: Gasoline type odour

CHEMICAL DATA: PACE reports the composition of unleaded gasoline sludges as follows:

Water	12%
Solids	45%
Oil	43%

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT: PACE reported the following contaminants in sludge:

- phenols 1.7-1.8 mg/Kg
- benzo(a)pyrene 0.3-0.9 mg/Kg

The same study showed the following metals present; Cadmium, Chromium, Cobalt, Copper, Lead, Mercury, Molybdenum, Nickel, Selenium, Vanadium and Zinc.
Organic dyes, anti-icing compounds.

POTENTIAL HAZARDS: The presence of many heavy metals and PNA's such as benzo-(a)-pyrene makes this material potentially hazardous to handle. Uncontrolled releases to the environment could cause contamination.

PERSONAL PROTECTION:

- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment is decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- Store in conventional steel tanks.
- Vapour control is necessary.
- Treat waste as if it were gasoline.

HANDLING PRECAUTIONS:

- In confined spaces, specific procedures must be followed. Use explosion-proof mechanical ventilation equipment.
- Prevent leaching of this waste sludge or the decontamination "washings" into the subsurface waters.
- This volatile material will pose a fire hazard.

NAME OF WASTE: UNLEADED GASOLINE TANK BOTTOMS **WASTE DATA SHEET NO.** I-2

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Subject to generator classification (see Part B, Section 2.3)

TYPE OF CARRIER: Provincially licensed vehicle approved for chemical sludges.

WAYBILLS REQUIRED:

LOADING/UNLOADING PRECAUTIONS: API Procedures for loading and unloading sludges should be followed.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: Unleaded gasoline is composed of several base stocks plus a number of additives such as manganese compounds, gum inhibitors, detergents, anti-icing compounds, dyes, etc. It is also possible for liquids such as Merox/caustic to be carried over from the process units into the component tanks and then into the final storage. Some additives such as inhibitors containing phenol and cresol may be added in the rundown streams and these have a capability of ending up in finished storage. Scale and rust will also be present particularly in external floating roof tanks. The 1985 survey shows that 47% of unleaded sludges are landfilled, 38% landfarmed, 5% incinerated off-site and 10% sent to outside contractors.

DISPOSAL GUIDELINE:

Acceptable:
- Landfarming
- Chemical fixation
- Secure landfill
- Incineration (with scrubber)

Not Recommended:
- Sanitary landfill
- Open dump burning

SECTION 7 - SELECTED REFERENCES

1. PACE Report No. 80-4 "Canadian Petroleum Refining Industry Waste Survey", 1980.

2. PACE Report No. 83-2 "The Significance of Trace Substances in Petroleum Industry Sludges Disposed of on Land", 1983.

3. American Petroleum Institute Publication 2015 "Cleaning of Petroleum Storage Tanks.

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WASTE DATA SHEET

NAME OF WASTE: CRUDE OIL TANK BOTTOMS

(SYNONYM)

SHEET NO. I-3

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Storage and Handling

GENERAL DESCRIPTION: Crude oil contains small quantities of sand and water which settle out in storage tanks and must be removed when the tank is serviced.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: 0.93 - 1.05

SOLUBILITY IN WATER: Extremely low.

APPEARANCE: Dark brown/black

ODOUR: Strong hydrocarbon odour.

CHEMICAL DATA: PACE reports the composition of crude tank bottoms to be:

	Range	Average
Water	13-50%	19%
Solids	12-90%	38%
Oil	10-100%	43%

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT: PACE summarized the trace metals as reported by 3 different researchers as follows:

	Range			Range			Range	
Arsenic	.003 - 53	mg/kg	Cadmium	0 - 16	mg/kg	Chromium	0.1 - 126	mg/kg
Cobalt	3.8 - 37	" "	Copper	0.7 - 500	" "	Iron	1270-34000	" "
Lead	0.1 - 358	" "	Manganese	11 - 1610	" "	Mercury	0 - 26	" "
Molybdenum	0.3 - 95	" "	Nickel	0.46-125	" "	Selenium	0 - 53	" "
Silver	.03 - 1.3	" "	Vanadium	0.5 - 223	" "	Zinc	0.1 - 825	" "

The composition of crude tank sludges will vary considerably depending on the source. Alberta crudes, according to Peake and Halowachuk, appear to be high in iron, manganese and zinc.

POTENTIAL HAZARDS: The presence of heavy metals mandates crude tank sludges must not be stored in any way which permits groundwater contamination. The high oil content of crude sludges, averaging 43%, dictate that they should be handled with care from a fire and explosion standpoint. Sulphide derivatives or iron may also be present. These are pyrophoric and can ignite spontaneously.

PERSONAL PROTECTION:
- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection should be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment is decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:
- May be stored in steel tanks.
- Vapour control is necessary.
- Pyrophoric materials may be present and appropriate fire protection must be considered

HANDLING PRECAUTIONS:
- In confined spaces specific procedures must be followed. Use explosion-proof mechanical ventilation equipment.
- Recognized API procedures must be followed for cleaning crude oil storage tanks.
- Prevent leaching of this waste sludge or the decontamination "washings" into the subsurface waters.
- Since hot cycle oil is used, a fire hazard exists and additional care must be taken.

NAME OF WASTE: CRUDE OIL TANK BOTTOMS **WASTE DATA SHEET NO.** I-3

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Subject to generator classification (see Part B, Section 2.3)

TYPE OF CARRIER: Licensed closed truck or equivalent carrier.

WAYBILLS REQUIRED: TDGA Provincial or Federal Manifest depending on classification.

LOADING/UNLOADING PRECAUTIONS: See handling precautions

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: Many refineries have installed mixers in their crude storage tanks to minimize sludge deposition. In spite of these mixers, there are still deposits to be removed when a tank is to be cleaned. Some of the newer types of mixers swing back and forth through an arc every few hours. These mixers have been found to be very efficient in slurrying up deposits and can be very cost effective in reducing overall costs. The current survey shows that 35% of crude bottoms are landfilled, 50% landfarmed, 10% reused or recycled and 5% incinerated.

DISPOSAL GUIDELINE:

Acceptable:
- Oil recovery on-site or off-site
- Landtreatment (landfarming)
- Incineration
- Secure landfill
- Chemical fixation

Not Recommended:
- Road oiling
- Sanitary landfill

SECTION 7 - SELECTED REFERENCES

1. PACE Report 80-4 "Canadian Petroleum Refining Industry Waste Survey" 1980.

2. PACE Report 83-2 "The Significance of Trace Substances in Petroleum Industry Sludges Disposed of on Land", 1983.

3. American Petroleum Institute Publication 2015 "Cleaning of Petroleum Storage Tanks"

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WASTE DATA SHEET

NAME OF WASTE: DISTILLATE TANK BOTTOMS

(SYNONYM)

SHEET NO. I-4

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Storage and Handling

GENERAL DESCRIPTION:

Sludges and sediments accumulate in the bottom of distillate tanks and must be disposed of when the tank is cleaned.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: 0.8 - 1.0

SOLUBILITY IN WATER: Slight

APPEARANCE: Brownish colour

ODOUR: Strong hydrocarbon odour

CHEMICAL DATA: There is limited data on composition but the PACE survey of 1980 provides the following:

	Range
Oil	1-5%
Water	10%
Solids	85%

May also contain small amounts of spent caustic and Merox.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT: Spent caustic and low levels of carcinogenic PNA's may be present. Otherwise sludge should be largely inert.

POTENTIAL HAZARDS: Those normally associated with hydrocarbons.

PERSONAL PROTECTION:

- Wear full, impervious protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment is decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- May be stored in steel vessels or concrete basins.

HANDLING PRECAUTIONS:

- In confined spaces specific procedures must be followed. Use explosion-proof mechanical ventilation equipment.
- Recognized API procedures must be followed for handling any tank sludge containing caustic materials.
- Prevent leaching of this waste sludge or the decontamination "washings" into the subsurface waters.

NAME OF WASTE: DISTILLATE TANK BOTTOMS **WASTE DATA SHEET NO.** I-4

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Generator to classify waste (see Part B, Section 2.3)

TYPE OF CARRIER: Provincially licensed vehicle approved for oily sludges.

WAYBILLS REQUIRED: TDGA provincial or federal manifest depending on classification.

LOADING/UNLOADING PRECAUTIONS: Care should be taken not to spill the sludge on the ground as groundwater contamination could result, where caustic is present. The safest way is to put the sludge into sealed drums. The bulk of the deposit in the tank is usually removed manually or by means of a vacuum truck. Traces are removed by a water flush or solvent rinse.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: The advent of hydrotreatment of middle distillates will tend to decrease the amount of sludge needing disposal. However, some plants still employ caustic washes and/or Merox fixed bed sweetening. In the latter processes some carry over can be expected with time. The current study shows that 30% of the sludge is landfilled, 60% landfarmed, 5% recycled and 5% goes to the water treatment system.

DISPOSAL GUIDELINE:

Acceptable:
- Landfarming
- Secure landfill
- Chemical fixation

Not Recommended:
- Sanitary landfill

SECTION 7 - SELECTED REFERENCES

1. PACE Report No. 80-4 "Canadian Petroleum Refining Industry Waste Survey, 1980"

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PACE

WASTE DATA SHEET

NAME OF WASTE: DECANT OIL TANK BOTTOMS

(SYNONYM) (CATALYTIC FRACTIONATION BOTTOMS)

SHEET NO. I-5

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Storage and Handling

GENERAL DESCRIPTION: Over a period of years a semi-solid build-up occurs in the bottom of decant oil tanks. The solids represent catalyst carry over from the bottom of the FCCU fractionation tower. Even with efficient cyclones catalyst will build up in the decant oil storage tank with time.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: 0.9 - 1.5

SOLUBILITY IN WATER: Nil

APPEARANCE: Black

ODOUR: Strong hydrocarbon odour

CHEMICAL DATA: The limited data from PACE in 1980 gives the following ranges:

	Range	Average
Oil	20 - 100%	34%
Water	0 - 20%	3%
Solids	60 - 90%	73%

The solids portion consists mainly of FCCU catalyst. Synthetic catalysts are composed mainly of Si/Alumina (12.5%). High alumina catalyst are more active and may have as much as 25% to 35% alumina content. Heavy metals from the crude oil may also be present in various organo-metallic compounds.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT: Significant levels of various PNA and organo-metallic compounds may be present, which have a wide range of toxic properties including possible carcinogenicity.

POTENTIAL HAZARDS: These bottoms are hazardous and must be handled with care. If landfilled or land treated (landfarmed), heavy metals find their way into groundwater, unless special care is taken in designing such facilities. Avoid skin contact as skin allergies may result in certain individuals.

PERSONAL PROTECTION:

- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment is decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- Storage in steel vessels is satisfactory.

HANDLING PRECAUTIONS:

- In confined spaces specific procedures must be used. Use explosion-proof mechanical ventilation equipment.
- Prevent leaching of this waste sludge or the decontamination "washings" into the subsurface waters.

NAME OF WASTE: DECANT OIL TANK BOTTOMS **WASTE DATA SHEET NO.** I-5

(SYNONYM): (CATALYTIC FRACTIONATION BOTTOMS)

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Generator to classify waste (see Part B, Section 2.3)

TYPE OF CARRIER: Provincially licensed vehicle approved for oily sludges.

WAYBILLS REQUIRED: TDGA provincial or federal manifest depending on classification.

LOADING/UNLOADING PRECAUTIONS:

Mixing with equal parts sand before transportation can assist in handling.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: This survey shows that 43% goes to landfill and 57% to landfarm. Depending upon the length of time the sludge has remained in the tank, the deposits will be either semi-solid or fluid. This can pose removal problems if the sludge has become fairly solid. One plant has used an old riveted tank over the years. The rivets are backed out, the plate removed and a front-end loader removes the several feet of semi-solids. Other plants try to slurry the deposits with hot cut back such as light cycle oil and use a mixer to slurry the deposits. Manual methods or a vacuum truck may then be used.

If deposited on a landfarm the degradation will be slow since the hydrocarbon components are known to break down slowly. Frequent aeration, low oil loadings and more time than usual are required to destroy the hydrocarbons.

DISPOSAL GUIDELINE:

Acceptable:
- Landfarming
- Incineration
- Secure landfill

Not Recommended:
- Sanitary landfill
- Road oiling

SECTION 7 - SELECTED REFERENCES

1. PACE Report 80-4 "Canadian Petroleum Refining Industry Waste Survey, 1980"

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WASTE DATA SHEET

NAME OF WASTE: BUNKER OIL TANK BOTTOMS

(SYNONYM)

SHEET NO. I-6

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Storage and Handling

GENERAL DESCRIPTION: Over a period of time sludges and sediment may accumulate in the bottom of bunker tanks and must be removed. If not removed then deposits can adversely affect the B.S.&.W. specification.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: 0.9 - 1.0

SOLUBILITY IN WATER: Slight

APPEARANCE: Black

ODOUR: Strong hydrocarbon odour

CHEMICAL DATA: Limited data in a PACE survey in 1980 provides the following:

	Range
Oil	25 - 95%
Water	5 - 30%
Solids	5 - 75%

The solids portion may contain FCCU catalyst, sediment and heavy metals present in the crude oil.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT: Crude oils contain a great number of heavy metals in trace amounts depending upon their source. Some of these metals are known to be associated with carcinogenicity and other effects as are the PNA's which may also be present in the sludges.

POTENTIAL HAZARDS: If landfilled or landfarmed, PNA's and heavy metals may find their way into the groundwater, unless special precautions are taken in designing such facilities. Skin and lung irritation.

PERSONAL PROTECTION:

- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment is decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- Store in steel vessels of any kind.

HANDLING PRECAUTIONS:

- In confined spaces specific procedures must be used. Use explosion-proof mechanical ventilation equipment.
- Prevent leaching of this waste sludge or the decontamination "washings" into the subsurface waters.

NAME OF WASTE: BUNKER OIL TANK BOTTOMS **WASTE DATA SHEET NO.** I-6

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Generator to classify waste (see Part B, Section 2.3)

TYPE OF CARRIER: Provincially licensed vehicle approved for oily sludges.

WAYBILLS REQUIRED: TDGA provincial or federal manifest depending on classification.

LOADING/UNLOADING PRECAUTIONS: Mixing with equal parts sand before transportation can assist in handling. Vacuum trucks are frequently used for picking up these sludges.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: This survey shows that 52% of the sludge is landfarmed, 34% landfilled, 7% recycled (presumably to a crude tank) and 7% incinerated offsite. The relatively high oil content (25-95%) normally makes this material a good candidate for some type of recovery and reuse. Incineration would cause some erosion to conventional steam atomizing burner types therefore some other approach to burning should be investigated. Removal from the storage tank is usually preceded by slurrying with hot cut back of some type thus recovering, to some degree, the hydrocarbon portion.

DISPOSAL GUIDELINE:

Acceptable:
- Recycling or Reclaiming
- Landfarming
- Secure landfill
- Incineration

Not Recommended:
- Municipal dump
- Sanitary landfill
- Road oiling

SECTION 7 - SELECTED REFERENCES

1. PACE Report No. 80-4 "Canadian Petroleum Refining Industry Waste Survey, 1980"

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WASTE DATA SHEET

NAME OF WASTE: SLOP OIL TANK BOTTOMS

(SYNONYM)

SHEET NO. I-7

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Storage and Handling

GENERAL DESCRIPTION: Slop oils have many impurities, some of them solid or semi-solid. These accumulate in the bottom of the tank and must be periodically removed.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: 0.8 - 1.0

SOLUBILITY IN WATER: Variable

APPEARANCE: Black

ODOUR: Strong hydrocarbon odour

CHEMICAL DATA: API conducted a survey of 49 plants with the following average percent concentrations:

Oil	21.7
Water	63.1
Solids	15.8

On a wet basis, the sludge was found to contain a median of 49 mg/Kg of lead and 13 mg/Kg of total chromium.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

The U.S. EPA has "listed" this waste because it may contain significant concentrations of Pb and Cr.

POTENTIAL HAZARDS: The heavy metal fractions can leach out into the groundwater especially when acidic conditions are present (unless special precautions are taken in designing the land treatment facilities). These metals could present environmental hazards and sking and lung irritation.

PERSONAL PROTECTION:

- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial proection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment is decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- Store in steel tanks or concrete basins.

HANDLING PRECAUTIONS:

- In confined spaces specific procedures must be used. Use explosion-proof mechanical ventilation equipment.
- Prevent leaching of this waste sludge or the decontamination "washings" into the subsurface waters.
- A broad range of volatile hydrocarbons can be present and will pose a fire hazard.

NAME OF WASTE: SLOP OIL TANK BOTTOMS **WASTE DATA SHEET NO.** I-7

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): 9375 **TDGR CLASSIFICATION:** 6.1

TYPE OF CARRIER: Provincially licensed vehicle approved for oily sludge transport.

WAYBILLS REQUIRED: TDGA provincial or federal manifest.

LOADING/UNLOADING PRECAUTIONS: This sludge is most safely handled by vacuum truck. If it must be transported, always use a closed truck.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: This survey showed that 75% of plants landfarm this sludge and 25% send it to landfill. Since the oil content is substantial and can be recovered, reclaiming should be investigated. The sludge might also be slurried and injected into the crude train or into the FCCU fractionation on a controlled basis. The latter is a safer injection point since lead is usually present and this could deactivate the platinum catalyst used in reforming.

DISPOSAL GUIDELINE:

Acceptable:
- Reclaiming of oil
- Recycling to FCCU
- Landfarming
- Incineration (with scrubbers)

Not Recommended:
- Sanitary landfill
- Road or dyke oiling

SECTION 7 - SELECTED REFERENCES

1. API "1982 Refinery Solids Waste Survey" by Environmental Resources Management Inc., West Chester, Pennsylvania (zip code 19380).
2. PACE Report No. 83-2 "The Significance of Trace Substances in Petroleum Industry Sludges Disposed of on Land", 1983.

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WASTE DATA SHEET

NAME OF WASTE: ASPHALT WASTE

(SYNONYM)

SHEET NO. I-8

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Storage and Handling

GENERAL DESCRIPTION: Asphalt waste results from customer returns, off specification product and asphalt which has been spilled on the ground, thereby picking up soil or gravel particles.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: 1 - 1.2

SOLUBILITY IN WATER: Nil

APPEARANCE: Black

ODOUR: Slight hydrocarbon odour

CHEMICAL DATA: Asphalt consists of hydrocarbons with a high number of carbon atoms in the molecule. Since crude oil contains a large number of heavy metals, most of them will be concentrated in the asphalt fraction.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT: Air oxidized asphalts emit H_2S when heated.

POTENTIAL HAZARDS :

- Burns from hot asphalt.
- As indicated above, H_2S could be present.

PERSONAL PROTECTION:

- Wear full, impervious, protective apparel such as insulated gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment is decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- Never put any waste asphalt in a "Hot Box" unless analysis shows that it contains no volatile fractions.
- Hot asphalts must be stored in vented containers.

HANDLING PRECAUTIONS:

- Cut-back asphalts contain volatile solvent fractions and appropriate fire prevention measures should be taken.
- If a "Hot Box" is used to liquify asphalt waste in drums, ensure that the drum is vented to avoid any danger of explosion.

NAME OF WASTE: ASPHALT WASTE **WASTE DATA SHEET NO.** I-8

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Generator to classify waste (see Part B, Section 2.3)

TYPE OF CARRIER: Provincially licensed carrier approved for asphalt transport.

WAYBILLS REQUIRED: TDGA provincial or federal manifest depending on classification.

LOADING/UNLOADING PRECAUTIONS: Care should be taken not to spill asphalt on the ground as it can be difficult to clean up. A good practice is to heap a pile of clean sand or saw dust nearby in case of a spill.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: While 61% of the reporting plants landfill waste asphalt, another 33% have some type of onsite reclaimer and 6% incinerate offsite. Some six plants have set up "hot boxes", usually steam heated, which can melt drums of asphalt so that it can be recycled or burned. Good success has been reported using this system.

DISPOSAL GUIDELINE:

Acceptable:
- Recycle and reuse
- Incineration

Not Recommended:
- Open dump burning

SECTION 7 - SELECTED REFERENCES

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PART A

WASTE DATA SHEET (WDS) INDEX

CODE II - PROCESS UNIT WASTES

WDS NO.	NAME OF WASTE	SYNONYM	DATE ISSUED/ REVISED
II-1	Desalter Sludge		November 1986
II-2	Phenolic Caustic		November 1986
II-3	Sulphidic Caustic		November 1986
II-4	HF Acid (Neutralized)	Neutralized HF Acid	November 1986
II-5	Sulphuric Acid (Spent)	Spent Alky Acid	November 1986
II-6	Clay (Spent)		November 1986
II-7	Activated Carbon (Spent)		November 1986
II-8	Amine Filters		November 1986
II-9	Off Specification Sulphur		November 1986
II-10	Furfural (Spent)	Furfuraldehyde Sludge	November 1986
II-11	Glycol (Spent)		November 1986
II-12	Coke Fines		November 1986
II-13	Stretford Solution		November 1986
II-14	FCCU Catalyst (Spent)		November 1986
II-15	Fluid Catalytic Cracker Unit Dust	FCCU - Cat	November 1986
II-16	Electrostatic Precipitator Dust (FCCU)	ESP - Dust	November 1986
II-17	Poly Unit Catalyst (Spent)		November 1986
II-18	Hydrogen Plant Catalyst (Spent)		November 1986
II-19	Reformer Catalyst (Spent)	Platformer Catalyst (Spent) Powerformer Catalyst (Spent)	November 1986
II-20	Hydrocracker Catalyst (Spent)	H.C. Catalyst (Spent)	November 1986
II-21	Hydrotreater Catalyst (Spent)		November 1986
II-22	Merox Catalyst (Spent)		November 1986
II-23	Copper Chloride Catalyst (Spent)		November 1986
II-24	Claus Plant Catalyst (Spent)	Spent Sulphur Plant Catalyst	November 1986
II-25	Hydrofluoric Acid Soluble Polymer	HF Polymer	November 1986

PACE

WASTE DATA SHEET

NAME OF WASTE: DESALTER SLUDGE

(SYNONYM)

SHEET NO. II-1

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: PROCESS UNITS - Desalters

GENERAL DESCRIPTION: Crude oils contain a small percentage of solids, most of which are discharged with the brine from the desalter. Over a period of time a sludge layer will build up in the bottom of the vessel. These solids must be removed when the desalter is shut down for routine maintenance or for repairs.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: 1 - 1.5

SOLUBILITY IN WATER: Low

APPEARANCE: Black, gel-like

ODOUR: Strong oily smell

CHEMICAL DATA: PACE gives the composition of desalter sludge as follows:

	Range	Average
Water	5 - 84.1%	53%
Solids	14.4 - 80%	21.5%
Oil	2 - 30%	25.5%

In addition, heavy metals may also be present. Inorganic salts such as calcium sulphate may also be present depending upon the desalter washwater composition and the crude origin.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

Heavy metals - Cr, Cu, Fe, Pb, Ni, Zn
H_2S could be present

POTENTIAL HAZARDS: In considering disposal methods the heavy metal fractions are susceptible to leaching out and can contaminate soil and groundwater, especially when acidic conditions are present, unless special precautions in the design of such facilities are provided. Skin and lung irritation.

PERSONAL PROTECTION:

- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintan good personal hygiene and ensure protective equipment is decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- Store in steel tanks or concrete basis.

HANDLING PRECAUTIONS:

- In confined spaces specific procedures must be followed. Use explosion-proof mechanical ventilation equipment.
- Prevent leaching of this waste sludge or the decontamination "washings" into the subsurface waters.

NAME OF WASTE: DESALTER SLUDGE **WASTE DATA SHEET NO.** II-1

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Subject to generator classification (See Part B, Section 2.3)

TYPE OF CARRIER: Provincially licensed vacuum truck or equivalent carrier.

WAYBILLS REQUIRED: TDGA Provincial or Federal Manifest

LOADING/UNLOADING PRECAUTIONS: Care should be taken in trucking. Open box trucks are not recommended as they present a spill hazard in case of a sudden stop.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: This surveys shows that 43% of the plants used landfarming, 34% landfill, 6% incineration, 11% is recycled and 6% goes to an outside contractor. Since the heavy metals concentration is low, landfarming should present no problems. When the oil content is above 15%, oil recovery might be considered.

In 1980 114000 Kg (2512000 lbs) of dry desalter sludge was disposed of at Canadian petroleum refineries.

DISPOSAL GUIDELINE:

Acceptable:
- Landfarming
- Oil Recovery
- Secure Landfill

Not Recommended:
- Disposal to an outside contractor, unless the facilities have been inspected by refinery personnel to determine suitable environmental protection.
- Burning at open dumps.

SECTION 7 - SELECTED REFERENCES

1. PACE Report No. 80-4 "Canadian Petroleum Refinery Industry Waste Survey", 1980.

2. PACE Report No. 81-5A "Landspreading of Sludges at Canadian Petroleum Facilities", December 1981.

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WASTE DATA SHEET

NAME OF WASTE: PHENOLIC CAUSTIC

(SYNONYM)

SHEET NO. II-2

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: PROCESS UNITS - Treatment of gasoline fractions, solvents, middle distillates, LPG, etc.

GENERAL DESCRIPTION: Caustic is used in varying strengths ranging from 5 to 25° Be to treat gasoline and middle distillate fractions, solvents, and LPG. Most of the spent caustic comes from the caustic washing of heavy catalytically cracked gasoline for mercaptan treatment. Acid oils removed by washing are usually reclaimed for making phenolic resins. The most common use of caustic is for removing small amounts of sulphides and mercaptans from petroleum products. Some plants mix the valuable acid oil (phenolic) containing caustic with sulphidic caustic to dispose of the latter, which has little or no commercial value. Caustic contaminated with Merox is often disposed of along with phenolic and sulphidic caustic.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: N/A

SOLUBILITY IN WATER: High

APPEARANCE: Beige to white

ODOUR: Mercaptan and sulphidic odour

CHEMICAL DATA: Phenolic spent caustic is composed of 10-25% acid oils (phenols, cresols) unreacted caustic soda, naphthenates, sulphides, mercaptans, hydrocarbons and water. Sulphidic caustic contains unreacted caustic soda, sulphides, mercaptans, naphthenates, hydrocarbons and water. Spent caustic from Merox treating will contain various iron compounds present in the Merox catalyst as well as caustic soda solution.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT: Hydrogen sulphide and odourous mercaptans.

POTENTIAL HAZARDS: All caustic solutions can cause skin burns and severe eye damage. Toxic gases such as H_2S and mercaptans may be evolved on contact with acids. Strong odours can result from improper handling. These can result in community complaints.

PERSONAL PROTECTION:
- Wear full, impervious protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment is decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:
- Store in tanks lined with materials impervious to this caustic waste.
- Tanks should be vented.
- A dedicated storage tank is desirable.

HANDLING PRECAUTIONS:
- In confined spaces specific procedures must be followed. Use explosion-proof mechanical ventilation equipment and corrosion resistant ducting.
- All piping connections may require stress relief.
- Prevent leaching of this waste or the decontamination "washings" into the subsurface waters.
- Gases such as H_2S or mercaptans can result from improper handling and may cause community complaints.

NAME OF WASTE: PHENOLIC CAUSTIC **WASTE DATA SHEET NO.** II-2

(SYNONYM)

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): 1824 **TDGR CLASSIFICATION:** 8, 9.2

TYPE OF CARRIER: Licensed provincial truck or rail car.

WAYBILLS REQUIRED: TDGA Provincial or Federal Manifest

LOADING/UNLOADING PRECAUTIONS: Extra care must be taken to ensure that leaks do not occur in transit. Personnel protection must be provided.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: In Canada the PACE questionnaire sent to petroleum plants prior to this Manual shows that 50% of the companies dispose of their waste caustic to a chemical company for acid oil reclamation. Some 17% goes to disposal wells while 33% goes to waste water treatment following neutralization under controlled conditions. See "Waste Water Treatment System". Care must be taken to introduce the neutralized caustic into the treatment system at a controlled rate. Dumping can have serious effects on the bacteria population of a biotreater. Raising the pH of the waste water can also seriously affect oil/water separation.

One refinery reports off-site incineration for phenolic caustic. Another recycles spent sulphidic caustic to a pulp mill while another plant uses it to adjust the pH of desalter water.

DISPOSAL GUIDELINE:

Acceptable:

- Reclamation to a chemical plant
- Re-use by a pulp mill
- Disposal wells
- Desalter pH adjustment (recycle)
- Neutralization with acid or flue gas before injection to waste water treatment
- Controlled injection to waste water treatment plant as dictated by effluent quality limits

Not Recommended:

- Direct uncontrolled injection to a waste water treatment plant
- Sanitary landfill

SECTION 7 - SELECTED REFERENCES

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WASTE DATA SHEET

NAME OF WASTE: SULPHIDIC CAUSTIC

(SYNONYM)

SHEET NO. II-3

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: PROCESS UNITS - Treatment of gasoline fractions, solvents, middle distillates, LPG, etc.

GENERAL DESCRIPTION: Caustic is used in varying strengths ranging from 5 to 25° Be to treat gasoline and middle distillate fractions, solvents, and LPG. Most of the spent caustic comes from the caustic washing of heavy catalytically cracked gasoline for mercaptan treatment. Acid oils removed by washing are usually reclaimed for making phenolic resins. The most common use of caustic is for removing small amounts of sulphides and mercaptans from petroleum products. Some plants mix the valuable acid oil (phenolic) containing caustic with sulphidic caustic to dispose of the latter, which has little or no commercial value. Caustic contaminated with Merox is often disposed of along with phenolic and sulphidic caustic.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: N/A

SOLUBILITY IN WATER: High

APPEARANCE: Beige to white

ODOUR: Mercaptan and sulphidic odour

CHEMICAL DATA: Phenolic spent caustic is composed of 10-25% acid oils (phenols, cresols) unreacted caustic soda, naphthenates, sulphides, mercaptans, hydrocarbons and water. Sulphidic caustic contains unreacted caustic soda, sulphides, mercaptans, naphthenates, hydrocarbons and water. Spent caustic from Merox treating will contain various iron compounds present in the Merox catalyst as well as caustic soda solution.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT: Hydrogen sulphide and odourous mercaptans.

POTENTIAL HAZARDS: All caustic solutions can cause skin burns and severe eye damage. Toxic gases such as H_2S and mercaptans may be evolved on contact with acids. Strong odours can result from improper handling. These can result in community complaints.

PERSONAL PROTECTION:

- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment is decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- Store in dedicated tanks lined with materials impervious to this caustic waste.
- Tanks should be vented.
- A dedicated storage tank is desirable.

HANDLING PRECAUTIONS:

- In confined spaces specific procedures must be followed. Use explosion-proof mechanical ventilation equipment and corrosion resistant ducting.
- All piping connections may require stress relief.
- Prevent leaching of this waste or the decontamination "washings" into the subsurface waters.
- Gases such as H_2S or mercaptans can result from improper handling and may cause community complaints.

NAME OF WASTE: SULPHIDIC CAUSTIC **WASTE DATA SHEET NO.** II-3

(SYNONYM)

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): 1824 **TDGR CLASSIFICATION:** 8, 9.2

TYPE OF CARRIER: Licensed provincial truck or rail car.

WAYBILLS REQUIRED: TDGA Provincial or Federal Manifest

LOADING/UNLOADING PRECAUTIONS: Extra care must be taken to ensure that leaks do not occur in transit. Personnel protection must be provided.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: In Canada the PACE questionnaire sent to petroleum plants prior to this Manual shows that 50% of the companies dispose of their waste caustic to a chemical company for acid oil reclamation. Some 17% goes to disposal wells while 33% goes to waste water treatment following neutralization under controlled conditions. See "Waste Water Treatment System". Care must be taken to introduce the neutralized caustic into the treatment system at a controlled rate. Dumping can have serious effects on the bacteria population of a biotreater. Raising the pH of the waste water can also seriously affect oil/water separation.

One refinery reports off-site incineration for phenolic caustic. Another recycles spent sulphidic caustic to a pulp mill while another plant uses it to adjust the pH of desalter water.

DISPOSAL GUIDELINE:

Acceptable:
- Reclamation to a chemical plant
- Re-use by a pulp mill
- Disposal wells
- Desalter pH adjustment (recycle)
- Neutralization with acid or flue gas before injection to waste water treatment
- Controlled injection to waste water treatment plant as dictated by effluent quality limits

Not Recommended:
- Direct uncontrolled injection to a waste water treatment plant
- Sanitary landfill

SECTION 7 - SELECTED REFERENCES

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WASTE DATA SHEET

NAME OF WASTE: HYDROFLUORIC ACID (NEUTRALIZED) **SHEET NO.** II-4

(SYNONYM) (NEUTRALIZED HF ACID) **DATE** November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Process Units - Hydrofluoric Alkylation Unit

GENERAL DESCRIPTION: Small quantities of hydrofluoric acid are released from various sections of the Alkylation Unit and are gravitated into a sump where the acid is neutralized either by caustic soda and/or by lime. If lime is used, a very insoluble sludge forms and must be removed periodically.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: 1 - 1.2

SOLUBILITY IN WATER: Extremely low.

APPEARANCE: Gray - white

ODOUR: Can be a strong odour during neutralization depending upon the hydrocarbon released.

CHEMICAL DATA: The composition of the liquid phase will depend on how much extra lime and/or caustic was used for neutralization. PACE Report No. 80-4 reports the following:

Oil - 0.5%
Solids - 33.0%
Water - 66.5%

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

- Fluorides of sodium and/or calcium
- Hydrocarbons

POTENTIAL HAZARDS: Neutralized HF sludges are non-listed wastes under the U.S. EPA classification system. All samples passed the toxicity, ignitability and reactivity test with only 11% failing the test for corrosivity.

PERSONAL PROTECTION:
- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment is decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:
- Store in tanks lined with materials impervious to this waste.
- A dedicated storage tank is desirable.

HANDLING PRECAUTIONS:
- In confined spaces specific procedures must be followed. Use explosion-proof mechanical ventilation equipment and corrosion resistant ducting.

NAME OF WASTE: HYDROFLUORIC ACID (NEUTRALIZED) **WASTE DATA SHEET NO.** II-4

(SYNONYM): (NEUTRALIZED HF ACID)

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted. **TDGR CLASSIFICATION:** Subject to generator classification (see Part B, Section 2.3)

TYPE OF CARRIER: Licensed carrier enclosed truck or tank car.

WAYBILLS REQUIRED: TDGA Provincial or Federal Manifest and placards required.

LOADING/UNLOADING PRECAUTIONS: Normal safe loading and unloading precautions required. Ensure all tank or vehicle flanges are tightly sealed to prevent leakage in transit.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: Current disposal practices in Canada are:

Landfill	- 43%
Waste Water Treatment	- 43%
Disposal Well	- 14%

In the U.S.A., 37% of the sludge is landfarmed, 50% landfilled, 23% added to the waste water treatment system and 13% other.

DISPOSAL GUIDELINE:

Acceptable:
- Chemical fixation
- Secure landfill
- Waste water treatment

Not Recommended:
- Sanitary landfill

SECTION 7 - SELECTED REFERENCES

1. PACE Report No. 80-4 "Canadian Petroleum Refining Industry Waste Survey", October 1980.

2. American Petroleum Institute "1982 Refinery Solid Wastes Survey" by Environmental Resources Management Inc., West Chester, Penn. 19380.

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WASTE DATA SHEET

NAME OF WASTE:	SULPHURIC ACID (SPENT)	**SHEET NO.**	II-5
(SYNONYM)	(SPENT ALKY ACID)	**DATE**	November 1986
		REV'N NO.	0

SECTION 1 - WASTE INFORMATION

SOURCE: Process Units - Sulphuric Acid Alkylation Unit

GENERAL DESCRIPTION: Sulphuric acid serves as a catalyst in the production of alkylate. In the process it becomes diluted, thereby reducing its effectiveness as a catalyst and making replacement with fresh acid necessary.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: 1.81 (20°C)

SOLUBILITY IN WATER: High

APPEARANCE: Brown/black

ODOUR: Hydrocarbon odour

CHEMICAL DATA:

Acid	90%
Inactive hydrocarbons and oxidation products	10%

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

Mainly active sulphuric acid

POTENTIAL HAZARDS:

This material is corrosive to tissue.

PERSONAL PROTECTION:
- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment is decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:
- Steel or lined tanks but not concrete.
- Avoid contact with any water as the rapid evolution of heat could result in a violent reaction.
- A dedicated storage tank is desirable.

HANDLING PRECAUTIONS:
- In confined areas specific procedures should be followed. Use explosion-proof mechanical ventilation equipment and corrosion resistant ducting.
- Exercise care when disconnecting any hoses, flanges or fittings which may be under pressure.
- Prevent any release of this material in the subsurface waters.

NAME OF WASTE: SULPHURIC ACID (SPENT) **WASTE DATA SHEET NO.** II-5

(SYNONYM): (SPENT ALKY ACID)

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): 1832 **TDGR CLASSIFICATION:** 8, 9.2

TYPE OF CARRIER: Certified truck suitable for industrial acids

WAYBILLS REQUIRED: TDGA Provincial or Federal Manifest required

LOADING/UNLOADING PRECAUTIONS: Avoid splashing and spills during loading or off-loading operations. Ensure vehicle carrying tanks are tightly sealed against potential leaks or spills in transit.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: Sulphuric acid serves only as a catalyst in the reaction between olefins and isoparaffins. Commonly isobutane and butenes are reacted in a sulphuric acid media to produce a high octane alkylate with a contact time of 20-40 minutes. An acid strength of 98% is used but during the process it is diluted to about 90% before it is discarded. Unactive hydrocarbons and certain oxidation products make up the contaminants. The spent acid is therefore not destroyed chemically and may be recovered for reuse.

Current studies show that 75% of the spent acid is sent to the supplier or a reclaimer while 25% in Quebec goes to Stablex.

DISPOSAL GUIDELINE:

Acceptable:
- Reclaiming
- Neutralization and Chemical Fixation

Not Recommended:
- Disposal in pits, lagoons or waste water treatment systems
- Sanitary landfill

SECTION 7 - SELECTED REFERENCES

1. Petroleum Refining Engineering by W.L. Nelson

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WASTE DATA SHEET

NAME OF WASTE: (SYNONYM) CLAY (SPENT)

SHEET NO. II - 6
DATE November 1986
REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Process Units
- clay filters for lube oils, base stocks, jet fuel & aromatics from BTX units

GENERAL DESCRIPTION: A variety of filter media are used for process purposes. Over a period of time the used filter media can be regenerated no longer and must be discarded.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: Clay (Fuller's earth dry) 0.50-0.56 **SOLUBILITY IN WATER:** Nil

APPEARANCE: Amber color.

CHEMICAL DATA:

Clay (Fuller's Earth) - SiO_2 - 48-73%, Al_2O_3 - 2-15%, Fe_2O_3 - 1-5%, also small amount of FeO, MgO, CaO, Na_2O, K_2O

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT: Depends upon material filtered, aromatics such as benzene could be present.

POTENTIAL HAZARDS: Presence of aromatics or other hazardous chemicals in clay filters dictate care.

PERSONAL PROTECTION: If a worksite evaluation indicates the likelihood of contact with a toxic or irritating agent, then relevant protection shall be worn, such as:
- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment is decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- Steel vessels should be satisfactory.

HANDLING PRECAUTIONS:

- In confined areas specific procedures must be followed. Where required, mechanical ventilation equipment shall be explosion-proof.
- Obeserve strict fire precautions where volatile hydrocarbons or other combustible gases may be present.

NAME OF WASTE: CLAY (SPENT) **WASTE DATA SHEET NO.** II-6

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted

TDGR CLASSIFICATION: Generator to classify waste (see Part B, Section 2.3) waste (see Part B, Section 2.3)

TYPE OF CARRIER: Provincially licensed carried approved for transport of solid waste. carrier approved for transport of solid waste.

WAYBILLS REQUIRED: TDGA Provincial or Federal manifest depending on classification.

LOADING/UNLOADING PRECAUTIONS:

- When saturated with hydrocarbons, care is needed to prevent fire.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND:

- PACE states that 10 refineries disposed of 392922 Kg (866000 lbs) of spent clay in 1980 of which 92% was landfilled and the remainder landfarmed. Currently 61% is landfilled, 31% landfarmed and 8% incinerated. Regeneration of the clay has proven difficult although there are proven processes.

DISPOSAL GUIDELINE:

Acceptable: - Sanitary landfill, Land Treatment (Landfarming), Incineration before Sanitary Landfilling

Not Recommended: - Open dump

SECTION 7 - SELECTED REFERENCES

1. API "1982 Refinery Solid Waste Survey" by Environmental Resources Management Inc., West Chester, Pennsylvania, U.S.A. (zip code 19380).
2. API "Manual on Disposal of Refinery Wastes", Volume III
3. PACE Report No. 80-4 "Canadian Petroleum Refining Industry Waste Survey, 1980"

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WASTE DATA SHEET

NAME OF WASTE: ACTIVATED CARBON (SPENT)
(SYNONYM)

SHEET NO. II - 7
DATE November 1986
REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Process Units

- Carbon filters used in Merox Units, asphalt odour removal, waste water treatment and H_2S plants.

GENERAL DESCRIPTION: Over a period of time the used activated carbon filter media can be regenerated no longer and must be discarded.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: Apparent 0.45 - 0.54 **SOLUBILITY IN WATER:** Nil

APPEARANCE: Black.

CHEMICAL DATA:

- Essentially pure carbon.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:
- Depends upon service - if used for H_2S removal, special care is needed.

POTENTIAL HAZARDS:
- Possible presence of H_2S in carbon filters used for asphalt fume collection can create a potentially hazardous situation.
- Carbon dust particles are explosive when mixed with air in a confined space. Avoid use of any equipment where an open spark is generated.

PERSONAL PROTECTION: If a worksite evaluation indicates the likelihood of contact with a toxic or irritating agent, then relevant protection shall be worn, such as:
- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment is decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:
- Steel vessels should be satisfactory.

HANDLING PRECAUTIONS:
- In confined areas specific procedures must be followed. Where required, mechanical ventilation equipment shall be explosion-proof.
- Observe strict fire precautions where volatile hydrocarbons or other combustible gases may be present.

NAME OF WASTE: ACTIVATED CARBON (SPENT) **WASTE DATA SHEET NO.** II-7

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted.

TDGR CLASSIFICATION: Generator to classify waste (see Part B, Section 2.3)

TYPE OF CARRIER: Provincially licensed carrier approved for transport of solid waste.

WAYBILLS REQUIRED: TDGA Provincial or Federal manifest depending on classification.

LOADING/UNLOADING PRECAUTIONS:

- If carbon is not wetted, a covered truck or closed container is needed.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND:

- Current study shows that 68% is landfilled, 8% landfarmed, 8% recycled offsite and 16% to an outside disposal contractor.

DISPOSAL GUIDELINE:

Acceptable: - Recycling to supplier or sanitary landfill

Not Recommended: - Open dump

SECTION 7 - SELECTED REFERENCES

1. API "1982 Refinery Solid Waste Survey" by Environmental Resources Management Inc., West Chester, Pennsylvania, U.S.A. (zip code 19380).
2. API "Manual on Disposal of Refinery Wastes", Volume III
3. PACE Report No. 80-4 "Canadian Petroleum Refining Industry Waste Survey, 1980"

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WASTE DATA SHEET

NAME OF WASTE: AMINE FILTERS
(SYNONYM)

SHEET NO. II - 8
DATE November 1986
REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Process Units

- amine filters used on gas sweeteners.

GENERAL DESCRIPTION: A variety of filter media are used for process purposes. Over a period of time the used filter media can be regenerated no longer and must be discarded.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: Amine Filters n/a

APPEARANCE: Beige.

CHEMICAL DATA:

- Diatomaceous earth filter media

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

- Low concentrations of heavy metals may be absorbed into media.
- Amines may be present.

POTENTIAL HAZARDS:

- Avoid use of any equipment where an open spark may be generated.
- Amines are irritating to skin and eyes.

PERSONAL PROTECTION: If a worksite evaluation indicates the likelihood of contact with a toxic or irritating agent, then relevant protection shall be worn, such as:
- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment is decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- Steel vessels should be satisfactory.

HANDLING PRECAUTIONS:

- In confined areas specific procedures must be followed. Where required, mechanical ventilation equipment shall be explosion-proof.
- Observe strict fire precautions where volatile hydrocarbons or other combustible gases may be present.

NAME OF WASTE: AMINE FILTERS **WASTE DATA SHEET NO.** II-8

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted.

TDGR CLASSIFICATION: Generator to classify waste (see Part B, Section 2.3)

TYPE OF CARRIER: Provincially licensed carrier approved for transport of solid waste.

WAYBILLS REQUIRED: TDGA Provincial or Federal manifest depending on classification.

LOADING/UNLOADING PRECAUTIONS:

- None.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND:

- Current study shows that 91% of spent amine filter media is landfilled and 9% landfarmed.

DISPOSAL GUIDELINE:

Acceptable:
- Sanitary landfill
- Land Treatment (Landfarming)

Not Recommended:
- Open dump

SECTION 7 - SELECTED REFERENCES

1. API "1982 Refinery Solid Waste Survey" by Environmental Resources Management Inc., West Chester, Pennsylvania, U.S.A. (zip code 19380).
2. API "Manual on Disposal of Refinery Wastes", Volume III
3. PACE Report No. 80-4 "Canadian Petroleum Refining Industry Waste Survey, 1980"

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WASTE DATA SHEET

NAME OF WASTE:	OFF SPECIFICATION SULPHUR	**SHEET NO.**	II-9
(SYNONYM)		**DATE**	November 1986
		REV'N NO.	0

SECTION 1 - WASTE INFORMATION

SOURCE: PROCESSING UNITS - Sulphur Recovery Plants

GENERAL DESCRIPTION: Occasionally sulphur becomes contaminated with soil from a sulphur block base pad or spills onto the ground occur. Due to malfunctions in the process, excessive hydrocarbons may be present making the sulphur unacceptable to a customer.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: 2.05

SOLUBILITY IN WATER: Nil

APPEARANCE: Yellow

ODOUR: No particular odour

CHEMICAL DATA:

Waste will be mostly sulphur but may include soil and/or hydrocarbons.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

None.

POTENTIAL HAZARDS: Stored sulphur can ignite producing strong gases such as SO_2. The spilling of sulphur can create low pH soil conditions which favour the leaching of heavy metals from the soil into the groundwater. Soil bacteria are adversely affected at concentrations above 100 ppm of sulphur in soil.

PERSONAL PROTECTION:

- If high concentrations of sulphur dust are measured at the worksite, approved and appropriate respiratory protection shall be worn.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- May be stored in concrete or steel tanks.

HANDLING PRECAUTIONS:

- Avoid generation of sulphur dusts as these can lead to explosions and fire.
- Prevent leaching into the subsurface waters.

NAME OF WASTE: OFF SPECIFICATION SULPHUR **WASTE DATA SHEET NO.** II-9

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): 1350 **TDGR CLASSIFICATION:** NR

TYPE OF CARRIER: Licensed provincial truck or tank car.

WAYBILLS REQUIRED: TDGA Provincial or Federal Manifest

LOADING/UNLOADING PRECAUTIONS:

No special precautions required with solid sulphur.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: The recent PACE survey shows that 58% of off specification sulphur was landfilled, 14% incinerated, and 28% recycled or reused. One plant recycles this waste to a fertilizer plant. Since most plants control SO_2 very closely, incineration with SO_2 production could be a problem.

DISPOSAL GUIDELINE:

Acceptable:
- Sanitary or secure landfill
- Recycling or reuse
- Incineration

Not Recommended:
- Storage in open pits with uncontrolled run-off for acidic water.

SECTION 7 - SELECTED REFERENCES

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WASTE DATA SHEET

NAME OF WASTE: FURFURAL (SPENT)

(SYNONYM) (FURFURALDEHYDE SLUDGE)

SHEET NO. II-10

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Process Units - Lube oil furfural extraction unit.

GENERAL DESCRIPTION: The refining of motor oils requires the removal of aromatics, asphaltenes, etc. which could cause sludge formation in engines. One of the selective solvents used for this purpose is furfuraldehyde. Removal of the impurities produces a black viscous sludge which must be disposed of.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: 1 - 1.2

SOLUBILITY IN WATER: Slightly soluble

APPEARANCE: Black

ODOUR: Aromatic

CHEMICAL DATA: Sludge consists of aromatics, asphaltenes, furfuraldehyde and water. Composition is 10% oil, 80% water, 10% solids.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

Furfuraldehyde and aromatic fractions are present in the extract or sludge.

POTENTIAL HAZARDS: Furfuraldehyde is irritating to the skin and eyes and the vapours are a lung irritant. Some of the aromatic fractions may be toxic. Avoid contact with strong alkalies or mineral acids, and heat or flames.

PERSONAL PROTECTION:

- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment is decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- Steel vessels are satisfactory.
- Vapour control is necessary.

HANDLING PRECAUTIONS:

- In confined spaces specific procedures must be followed. Use explosion-proof mechanical ventilation equipment.
- Avoid contact with strong acids or oxidizers.
- Prevent leaching of this waste sludge or the decontamination "washings" into subsurface waters.

NAME OF WASTE: FURFURAL (SPENT) **WASTE DATA SHEET NO.** II-10

(SYNONYM): (FURFURALDEHYDE SLUDGE)

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): 1199 **TDGR CLASSIFICATION:** 3.2, 9.2

TYPE OF CARRIER: Provincially licensed carrier or equivalent.

WAYBILLS REQUIRED: TDGA Provincial or Federal manifest required dependent on waste classification.

LOADING/UNLOADING PRECAUTIONS:

Special precautions with this material due to potential hazards (see Section 3).

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND:

Furfural is still widely used for refining of motor oils but hydrogen treating is slowly replacing this process. The sludge is usually mixed with the refinery liquid and burned. The daily quantities are small and no adverse effects should result.

DISPOSAL GUIDELINE:

Acceptable: - Incineration

Not Recommended:
- Sanitary landfill
- Open dump burning

SECTION 7 - SELECTED REFERENCES

1. Perry, J.H., Chemical Engineers Handbook.
2. Georgi, C.W., Motor Oils and Engine Lubrication
3. Lewis, R.T., Sax, Irving, Rapid Guide to Hazardous Chemicals in the Workplace.

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WASTE DATA SHEET

NAME OF WASTE: GLYCOL (SPENT)

(SYNONYM)

SHEET NO. II-11

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Processing Units

GENERAL DESCRIPTION: Ethylene glycol is used in the cooling jackets of vehicles and stationary engines as well as for a recirculating pump coolant in the processing unit. One plant uses a glycol/water mixture to remove exchanger heat to an air cooler in place of cooling towers.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: 1.05 - 1.16

SOLUBILITY IN WATER: Miscible

APPEARANCE: Clear or coloured

ODOUR: Pleasant

CHEMICAL DATA: Ethylene glycol ($CH_2.OH.CH_2.OH$) is usually mixed with water in a 1:1 ratio and if used in engine cooling will contain borax plus some type of monomolecular amine film agent. Other additives may be present as well.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

Glycol solutions.

POTENTIAL HAZARDS:

- Moderate irritant to skin, eyes and mucous membranes.
- Toxic if ingested.

PERSONAL PROTECTION:

- Avoid skin or eye contact.
- At elevated temperatures, approved respiratory protection appropriate to the health hazard measured shall be worn.
- Encourage good personal hygiene.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

-Steel vessels are satisfactory.

HANDLING PRECAUTIONS:

- Avoid release of this material into subsurface waters.
- No special handling precautions are needed.

NAME OF WASTE: GLYCOL (SPENT) **WASTE DATA SHEET NO.** II-11

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Subject to generator classification (See Part B, Section 2.3)

TYPE OF CARRIER: Provincially licensed closed truck suitable for liquid chemicals or equivalent.

WAYBILLS REQUIRED: TDGA Provincial or Federal manifest dependent on waste classification.

LOADING/UNLOADING PRECAUTIONS: No special problems.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND:

One plant reporting on this waste disposes of spent glycol/water mixtures by incineration.

DISPOSAL GUIDELINE:

Acceptable:
- Incineration
- Chemical fixation
- Waste water treatment system (with a biotreater)

Not Recommended:
- Sanitary landfill
- Open dump burning

SECTION 7 - SELECTED REFERENCES

1. Sax, N.I., Lewis, R.J., Rapid Guide to Hazardous Chemicals in the Workplace.

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WASTE DATA SHEET

NAME OF WASTE: COKE FINES

(SYNONYM)

SHEET NO. II-12

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: PROCESS UNITS - Delayed Coker Units

GENERAL DESCRIPTION: Coke which accumulates in the coking drums is removed mechanically and then with high pressure water. In the cleaning process coke fines settle out in tank or gravity separators and must be removed periodically.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: 0.8 - 1.0

SOLUBILITY IN WATER: Low

APPEARANCE: Black

ODOUR: Slight hydrocarbon odour.

CHEMICAL DATA:

The coke fines consist mainly of carbon.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

Coke fines will contain heavy metals depending upon the source of the crude oil.

POTENTIAL HAZARDS:

Coke fines are ignitable and could ignite spontaneously under certain conditions.

PERSONAL PROTECTION:

Dry Coke Fines:
- Full clothing and eye protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazard shall be worn.
- Encourage good personal hygiene and ensure protective equipment is decontaminated after each use.

When handling as a wet sludge, respiratory protection will not be necessary.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:
- The wet sludge may be stored in steel or concrete vessels with due care to spontaneous combustion.

HANDLING PRECAUTIONS:
- In confined spaces specific procedures must be followed for handling dry coke fines. Use explosion-proof mechanical ventilation equipment for handling dry fines in confined spaces.
- Dry fines can create an explosive mixture in air and appropriate fire precautions should be taken.
- Prevent release of this material or the decontamination washings into the subsurface waters.
- Dry coke fines are ignitable and spontaneous ignition is possible under certain conditions.

NAME OF WASTE: COKE FINES **WASTE DATA SHEET NO.** II-12

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Subject to generator classification (See Part B, Section 2.3)

TYPE OF CARRIER: Licensed provincial truck or rail car.

WAYBILLS REQUIRED: Provincial Waste Manifest

LOADING/UNLOADING PRECAUTIONS:

No special precautions required.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND:

In Canada, 76% of coke fines go to landfill, 12% to fixation and secure landfill, and 12% are reused as a fuel off-site.

DISPOSAL GUIDELINE:

Acceptable:

- Sanitary or Secure Landfill depending on heavy metals content
- Re-use as a fuel off-site
- Chemical fixation

Not Recommended:

- Landfarm

SECTION 7 - SELECTED REFERENCES

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WASTE DATA SHEET

NAME OF WASTE: STRETFORD SOLUTION

(SYNONYM)

SHEET NO. II-13

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Stretford Sulphur Plant

GENERAL DESCRIPTION: This low pressure process in capable of selectively removing H_2S from a gas stream, recovering sulphur in the process. The anthraquinone is reduced to hydroquinone by H_2S producing elemental sulphur and water. The hydroquinone is air oxidized back to anthraquinone.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: 1.0

SOLUBILITY IN WATER: High

APPEARANCE: N/A

ODOUR: Variable

CHEMICAL DATA: Chemical composition of Stretford Solution:

Oil - Nil

Water - 95.5%

Solids - 4.5%

Heavy metals: Cr - 2-140 ppm(w)

Pb - 1-160 ppm(w)

Sodium carbonate - bicarbonate, disulphonic acid and sodium salt of anthraquinone- 0.5%

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT: A number of heavy metals were detected in leachate from the E.P. Toxicity Test but only chromium and lead appeared in significant quantities. Chromium values sometimes exceeded the maximum permissible for this test. Hydroquinone.

POTENTIAL HAZARDS: Stretford Solution is a "non listed" waste according to the EPA classification system for hazardous wastes. However, 40% of the samples tested by EPA failed the E.P. Toxicity Test.
Hydroquinone may cause skin allergies.

PERSONAL PROTECTION:

- Full clothing and eye protection shall be worn.
- Encourage good personal hygiene.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- Store in steel or concrete vessels.

HANDLING PRECAUTIONS:

- Prevent release of this material into the subsurface waters.

NAME OF WASTE: STRETFORD SOLUTION **WASTE DATA SHEET NO.** II-13

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Generator to classify waste (see Part B, Section 2.3)

TYPE OF CARRIER: Provincially licensed truck or tank car designed for liquid chemicals

WAYBILLS REQUIRED: TDGA Provincial or Federal manifest depending on classification.

LOADING/UNLOADING PRECAUTIONS: Follow same loading and unloading precautions as applied to alkali wastes. Provide personnel protection against skin and eye contact. Carry out safety inspection to ensure all valves and flanges on carrier are sealed prior to transport.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND:

In Canada the Stretford Solution, where used, is directed to the waste water treatment plant.

DISPOSAL GUIDELINE:

Acceptable: - Waste water treatment system.

Not Recommended: - Sanitary landfill.

SECTION 7 - SELECTED REFERENCES

1. API "1982 Refinery Solid Wastes Survey" by Environmental Resources Management Inc., West Chester, Pennsylvania, U.S.A. (zip code 19380).

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WASTE DATA SHEET

NAME OF WASTE: FCCU CATALYST (SPENT)

(SYNONYM)

SHEET NO. II - 14

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: PROCESSING UNIT - FCCU Unit

GENERAL DESCRIPTION: In order to maintain catalyst activity, it is usually necessary to withdraw catalyst from the FCCU system and replace it with new high activity catalyst. The spent catalyst must be discarded. Heavy metals such as nickel and vanadium and to a lesser extent iron and copper, act as a dehydrogenation catalyst producing excessive quantities of hydrogen and coke. Catalyst fines are also collected by external cyclones, and since they have a particle size which precludes their usefulness as a catalyst, they too must be disposed of.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: N/A

SOLUBILITY IN WATER: Nil

APPEARANCE: Beige or light gray

ODOUR: None

CHEMICAL DATA: The composition is proprietary information but API report that spent catalyst contains Pb, Cr, As, Ni, Cu, Se, V, Ag. Carbon content varies from 0.05% to 0.50% by weight.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT: Pb, Cr, As, Ni, Cu, Se, V, Ag. Spent catalyst and fines are non "listed" according to EPA.

POTENTIAL HAZARDS: None likely but skin and lung irritation could occur.

PERSONAL PROTECTION:

- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment is decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- Store in closed vessels.

HANDLING PRECAUTIONS:

- Wetting down the spent catalyst can reduce dust.
- In confined spaces specific procedures must be followed.
- Avoid dust generation.

NAME OF WASTE: FCCU CATALYST (SPENT) **WASTE DATA SHEET NO.** II-14

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Subject to generator classfication (see Part B, Section 2.3)

TYPE OF CARRIER: Provincially licensed closed truck or equivalent carrier.

WAYBILLS REQUIRED: TDGA Provincial or Federal Manifest dependent on classification.

LOADING/UNLOADING PRECAUTIONS: Avoid dusting and inhalation of catalyst fines particulates during loading and unloading operations.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: In 1980 according to PACE, 18 plants declared a total of 2930127 kg (6458000 lbs) of spent catalyst which corresponds to 1.9 kg/year/m^3 of FCCU throughput. Of this total, 63% was sold to other companies for reuse, 37% landfilled. This study shows that 54% of the plants used landfill, 41% sold and 5% went to landfarm.

Landfilling is used exclusively for fines disposal.

DISPOSAL GUIDELINE:

Acceptable:
- Recycle
- Sanitary Landfill (wetted down)
- Chemical fixation
- Reuse as feed to cement kiln

Not Recommended:
- Dry disposal into open dump or landfill
- Landfarming

SECTION 7 - SELECTED REFERENCES

1. American Petroleum Institute "1982 Refinery Solid Waste Survey" by Environmental Resources Management Inc., West Chester, Pennsylvania, U.S.A. (zip code 19380).

2. PACE Report No. 80-4 "Canadian Petroleum Refinery Industrial Waste Survey" 1980.

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WASTE DATA SHEET

NAME OF WASTE: FLUID CATALYTIC CRACKER UNIT DUST

(SYNONYM) (FCCU CAT)

SHEET NO. II - 15

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: PROCESSING UNIT - FCCU Unit

GENERAL DESCRIPTION: In order to maintain catalyst activity, it is usually necessary to withdraw catalyst from the FCCU system and replace it with new high activity catalyst. The spent catalyst must be discarded. Heavy metals such as nickel and vanadium and to a lesser extent iron and copper, act as a dehydrogenation catalyst producing excessive quantities of hydrogen and coke. Catalyst fines are also collected by external cyclones, and since they have a particle size which precludes their usefulness as a catalyst, they too must be disposed of.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: N/A

SOLUBILITY IN WATER: Nil

APPEARANCE: Beige or light gray

ODOUR: None

CHEMICAL DATA: The composition is proprietary information but API report that spent catalyst contains Pb, Cr, As, Ni, Cu, Se, V, Ag. Carbon content varies from 0.05% to 0.50% by weight.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT: Pb, Cr, As, Ni, Cu, Se, V, Ag. Spent catalyst and fines are non "listed" according to EPA.

POTENTIAL HAZARDS:

None likely but skin and lung irritation could occur.

PERSONAL PROTECTION:

- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment is decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- Store in closed vessels.

HANDLING PRECAUTIONS:

- Wetting down the spent catalyst can reduce dust.
- In confined spaces specific procedures must be followed.
- Avoid dust generation.

NAME OF WASTE: FLUID CATALYTIC CRACKER UNIT DUST **WASTE DATA SHEET NO.** II-15

(SYNONYM): (FCCU CAT)

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Subject to generator classfication (see Part B, Section 2.3)

TYPE OF CARRIER: Provincially licensed closed truck or equivalent carrier.

WAYBILLS REQUIRED: TDGA Provincial or Federal Manifest dependent on classification.

LOADING/UNLOADING PRECAUTIONS: Avoid dusting and inhalation of catalyst fines particulates during loading and unloading operations.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: In 1980 according to PACE, 18 plants declared a total of 2930127 kg (6458000 lbs) of spent catalyst which corresponds to 1.9 kg/year/m^3 of FCCU throughput. Of this total, 63% was sold to other companies for reuse, 37% landfilled. This study shows that 54% of the plants used landfill, 41% sold and 5% went to landfarm.

Landfilling is used exclusively for fines disposal.

DISPOSAL GUIDELINE:

Acceptable:
- Recycle
- Sanitary Landfill (wetted down)
- Chemical fixation
- Reuse as feed to cement kiln

Not Recommended:
- Dry disposal into open dump or landfill
- Landfarming

SECTION 7 - SELECTED REFERENCES

1. American Petroleum Institute "1982 Refinery Solid Waste Survey" by Environmental Resources Management Inc., West Chester, Pennsylvania, U.S.A. (zip code 19380).

2. PACE Report No. 80-4 "Canadian Petroleum Refinery Industrial Waste Survey" 1980.

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WASTE DATA SHEET

NAME OF WASTE: ELECTROSTATIC PRECIPITATOR DUST (FCCU) **SHEET NO.** II - 16

(SYNONYM) (ESP DUST) **DATE** November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: PROCESSING UNIT - FCCU Unit

GENERAL DESCRIPTION: In order to maintain catalyst activity, it is usually necessary to withdraw catalyst from the FCCU system and replace it with new high activity catalyst. The spent catalyst must be discarded. Heavy metals such as nickel and vanadium and to a lesser extent iron and copper, act as a dehydrogenation catalyst producing excessive quantities of hydrogen and coke. Catalyst fines are also collected by external cyclones, and since they have a particle size which precludes their usefulness as a catalyst, they too must be disposed of.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: N/A **SOLUBILITY IN WATER:** Nil

APPEARANCE: Beige or light gray **ODOUR:** None

CHEMICAL DATA: The composition is proprietary information but API report that spent catalyst contains Pb, Cr, As, Ni, Cu, Se, V, Ag. Carbon content varies from 0.05% to 0.50% by weight.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT: Pb, Cr, As, Ni, Cu, Se, V, Ag. Spent catalyst and fines are non "listed" according to EPA.

POTENTIAL HAZARDS: None likely but skin and lung irritation could occur.

PERSONAL PROTECTION:

- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment is decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- Store in closed vessels.

HANDLING PRECAUTIONS:

- Wetting down the spent catalyst can reduce dust.
- In confined spaces specific procedures must be followed.
- Avoid dust generation.

NAME OF WASTE: ELECTROSTATIC PRECIPITATOR DUST (FCCU) **WASTE DATA SHEET NO.** II-16

(SYNONYM): (ESP DUST)

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Subject to generator classfication (see Part B, Section 2.3)

TYPE OF CARRIER: Provincially licensed closed truck or equivalent carrier.

WAYBILLS REQUIRED: TDGA Provincial or Federal Manifest dependent on classification.

LOADING/UNLOADING PRECAUTIONS: Avoid dusting and inhalation of catalyst fines particulates during loading and unloading operations.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: In 1980 according to PACE, 18 plants declared a total of 2930127 kg (6458000 lbs) of spent catalyst which corresponds to 1.9 kg/year/m^3 of FCCU throughput. Of this total, 63% was sold to other companies for reuse, 37% landfilled. This study shows that 54% of the plants used landfill, 41% sold and 5% went to landfarm.

Landfilling is used exclusively for fines disposal.

DISPOSAL GUIDELINE:

Acceptable:
- Recycle
- Sanitary Landfill (wetted down)
- Chemical fixation
- Reuse as feed to cement kiln

Not Recommended:
- Dry disposal into open dump or landfill
- Landfarming

SECTION 7 - SELECTED REFERENCES

1. American Petroleum Institute "1982 Refinery Solid Waste Survey" by Environmental Resources Management Inc., West Chester, Pennsylvania, U.S.A. (zip code 19380).

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WASTE DATA SHEET

NAME OF WASTE: POLY UNIT CATALYST (SPENT)
SHEET NO. II-17
(SYNONYM)
DATE November 1986
REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: PROCESS UNITS - Polymerization Unit

GENERAL DESCRIPTION: Phosphoric acid, usually as an admixture with keiselguhr, magnesia, alumina or zinc chloride and calcined at 180-250°C, is used as a catalyst to convert olefinic gases into a liquid gasoline component.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: N/A
SOLUBILITY IN WATER: Slight
APPEARANCE: Gray
ODOUR: None

CHEMICAL DATA:

Phosphoric acid is active material supported on a calcined carrier such as kieselguhr.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

Phosphoric acid.

POTENTIAL HAZARDS:

Leachate can, via groundwater migration to water, create a problem due to promotion of algae formation. Phosphoric acid is irritating to tissue.

PERSONAL PROTECTION:
- Wear full, impervious, protection apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment is decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- Store in steel vessels.

HANDLING PRECAUTIONS:

- In confined spaces specific procedures must be followed.
- Avoid dust generation.

NAME OF WASTE: POLY UNIT CATALYST (SPENT) **WASTE DATA SHEET NO.** II-17

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Subject to generator classification (See Part B, Section 2.3)

TYPE OF CARRIER: Licensed truck or tank car.

WAYBILLS REQUIRED: TDGA Provincial or Federal Manifest

LOADING/UNLOADING PRECAUTIONS: Avoid generating dust when loading or unloading solid catalyst. Provide personnel with skin, eye and respiratory protection.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: In 1980 PACE reported that 66% was landfilled, 27% landfarmed and 7% incinerated. In 1985 the survey conducted for this Manual showed that 42% was landfilled, 30% landfarmed while 14% went to fixation and 14% was recycled on-site presumably for soil improvement. One refinery reported that it neutralizes the catalyst first with the liquid washings going to the waste water treatment system and the solids to landfill.

DISPOSAL GUIDELINE:

Acceptable:
- Secure landfill
- Landfarming
- Chemical fixation
- Nutrient for waste water treatment plant

Not Recommended:
- Sanitary landfill

SECTION 7 - SELECTED REFERENCES

1. PACE Report No. 80-4 "Canadian Petroleum Refinery Industry Waste Survey", 1980.

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WASTE DATA SHEET

NAME OF WASTE: HYDROGEN PLANT CATALYST (SPENT)

(SYNONYM)

SHEET NO. II-18

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Process Units - Hydrogen Plant

GENERAL DESCRIPTION: Hydrogen plays an increasing role in the upgrading of petroleum products and the supply from reformers is usually not sufficient to meet the demand. Hydrogen plants are now common place using naphtha or natural gas as a base stock. The reaction is made possible by a catalyst which must be discarded periodically.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: N/A

SOLUBILITY IN WATER: Nil

APPEARANCE: Extruded cylinders

ODOUR: None

CHEMICAL DATA:

First Stage:	Co/Mo on aluminum base
Second Stage:	NiO on aluminum base
Shift Converter:	Fe_2O_3 and CuO on ZnO and aluminum

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

Co, Cu and Ni are considered hazardous by Alberta on account of their persistent bioaccumulative characteristics and toxicities.

POTENTIAL HAZARDS:

Possible skin or lung irritation from dust. Unless secure landfill is used for disposal groundwater contamination from heavy metals may result.

PERSONAL PROTECTION:

- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- Store in steel vessels.

HANDLING PRECAUTIONS:

- In confined spaces specific procedures must be followed.
- Minimize dust generation during handling.

NAME OF WASTE: HYDROGEN PLANT CATALYST (SPENT) **WASTE DATA SHEET NO.** II-18

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Subject to generator classificatin (see Part B, Section 2.3)

TYPE OF CARRIER: Provincially licensed closed truck or equivalent carrier.

WAYBILLS REQUIRED: TDGA provincial or federal manifest depending on classification.

LOADING/UNLOADING PRECAUTIONS:

Avoid creation of dust and inhalation of catalyst fines.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND:

The current study shows that 61% of the catalyst is reclaimed offsite, 13% goes to secure landfill, and 26% goes to sanitary landfill. The decision to reclaim will depend upon the availability of a reclaiming plant and transportation costs.

DISPOSAL GUIDELINE:

Acceptable:
- Reclaiming of metals
- Chemical fixation
- Secure landfill

Not Recommended:
- Sanitary landfill

SECTION 7 - SELECTED REFERENCES

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WASTE DATA SHEET

NAME OF WASTE: REFORMER CATALYST (SPENT)

(SYNONYM) (PLATFORMER CATALYST (SPENT))
(POWERFORMER CATALYST (SPENT)

SHEET NO. II-19

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: PROCESSING UNITS - Catalyst Reformer Units

GENERAL DESCRIPTION: Platinum precipitated on alumina (aluminum oxide) with small additions of chlorine and/or fluorine is used as a catalyst to convert straight run naphtha into high octane reformate. Over a period of time the catalyst surface becomes deactivated and must be replaced. After the catalyst is removed from the batch reactors it is usually screened and drummed for shipment back to the supplier.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: N/A

SOLUBILITY IN WATER: Very low.

APPEARANCE: Whitish gray

ODOUR: None

CHEMICAL DATA:

The platinum concentration varies and is usually less than 0.75% wt, the rest being alumina and sometimes a second heavy metal to render the platinum more active. In addition, the catalyst will contain up to 1.1% wt. chlorine.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

POTENTIAL HAZARDS: Inhalation of dust during screening.

PERSONAL PROTECTION:
- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment is decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- Can be stored in steel drums for return to suppliers.

HANDLING PRECAUTIONS:

- After removal from reactor the spent catalyst is screened and drummed and dust generation should be minimized.
- In confined spaces specific procedures must be followed.

NAME OF WASTE: REFORMER CATALYST (SPENT) **WASTE DATA SHEET NO.** II-19

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Subject to generator classification (See Part B, Section 2.3)

TYPE OF CARRIER: Licensed truck or tank car.

WAYBILLS REQUIRED: TDGA Provincial or Federal Manifest.

LOADING/UNLOADING PRECAUTIONS:

Care should be taken to avoid dust inhalation.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: Due to the value of the platinum remaining on the alumina carrier, it is common practice to return the spent catalyst to the supplier for credit against the replacement catalyst.

DISPOSAL GUIDELINE:

Acceptable: - Reclaiming by supplier

Not Recommended:

SECTION 7 - SELECTED REFERENCES

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WASTE DATA SHEET

NAME OF WASTE: HYDROCRACKER CATALYST (SPENT)

(SYNONYM) (H.C. CATALYST (SPENT))

SHEET NO. II-20

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Process Units - Hydrocracking Unit

GENERAL DESCRIPTION: Hydrocracking is a process in which hydrocarbons are converted under hydrogen pressure into products of lower molecular weight. Normally distillates are used as feedstock producing gasoline but residual oils have been processed as well using special catalysts. The process may be carried out in a single stage if the nitrogen and sulphur content is low but usually two stages are used.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: N/A

SOLUBILITY IN WATER: Nil

APPEARANCE: Dark colour

ODOUR: Depends on hydrocarbon treated

CHEMICAL DATA:

Single Stage System: Co/Mo on fluorine promoted alumina
W/Ni on fluorine promoted Si/Mg
Ni/Mo on fluorine promoted Si/Mg

Two Stage System - First Stage: Co/Mo on alumina, Co/Mo on Si/alumina, W/Ni on alumina
Second Stage:Ni on Si/alumina, W/Ni on fluorine promoted Si/alumina
Pt or palladium on Y type Zeolite.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

The presence of cobalt and nickel would render these catalysts hazardous according to Alberta's classification system. There is a potential for nickel carbonyl being present.

POTENTIAL HAZARDS: The spent catalyst may contain pyrophoric material and should be stored or shipped under a nitrogen blanket to avoid spontaneous combustion. Before entering a vessel that contained spent catalyst, the air space should be tested for the possible presence of nickel carbonyl and appropriate safeguards taken. Inhalation of dust from the catalysts must be avoided as heavy metals and halogenated compounds are associated with carcinogenicity. The catalysts also have the potential to leach into groundwater if stored on the ground or disposed of to leaky landfill sites.

PERSONAL PROTECTION:

- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- Store in steel dums or containers.

HANDLING PRECAUTIONS:

- In confined spaces specific procedures must be followed. Use explosion-proof mechanical ventilation equipment.
- If hydrocarbon vapours are detected in catalyst, additional care must be taken.
- Minimize dust generation.

NAME OF WASTE: HYDROCRACKER CATALYST (SPENT) **WASTE DATA SHEET NO.** II-20

(SYNONYM): (H.C. CATALYST (SPENT))

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Subject to generator classification (See Part B, Section 2.3)

TYPE OF CARRIER: Provincially licensed closed truck or equivalent carrier.

WAYBILLS REQUIRED: TDGA provincial or federal manifest dependent on waste classification.

LOADING/UNLOADING PRECAUTIONS: Loading and transport under nitrogen blanket is advisable to avoid spontaneous combustion. Avoid stirring up dust. Transport in covered vehicle, not in open truck. Sealed drums are advisable.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: The current study shows that 40% of the reporting plants dispose of their catalyst by sanitary landfill, 40% by reclaiming and the remainder to secure landfill. This compares with 34% to reclaiming and 66% to landfill in the 1980 PACE survey. The decision to reclaim will depend upon the availability of a reclaimer and transportation costs.

DISPOSAL GUIDELINE:

Acceptable:
- Chemical fixation
- Reclaiming
- Secure landfill

Not Recommended:
- Land Treatment (Landfarming)
- Sanitary landfill

SECTION 7 - SELECTED REFERENCES

1. Hydrocarbon Processing, September 1974.

2. PACE Report No. 80-4 "Canadian Petroleum Refining Industry Waste Survey" 1980.

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WASTE DATA SHEET

NAME OF WASTE: HYDROTREATER CATALYST (SPENT)

(SYNONYM)

SHEET NO. II-21

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: PROCESS UNITS - Hydrotreaters and Hydrodesulphurization Units

GENERAL DESCRIPTION: In recent years hydrogen treating of various distillates to improve quality, and to remove sulphur from catalytic reformer feedstocks and even residual oils have become commonplace. Some of the various processes employing hydrogen are Unifining, Hydrofining, Sovafining, Shell Trickle-Phase Hydro-desulphurization process, Gulf H.D.S. Hydro pretreating, Hydrobon Autofining, Hydrotreating, Desulforming, Gulfining, and Ultrafining. All of the processes employ a catalyst which requires removal from the fixed reactor bed.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: 0.5 - 0.9

SOLUBILITY IN WATER: Nil

APPEARANCE: Varies

ODOUR: None

CHEMICAL DATA: Hydrotreater catalyst typically consists of cobalt-molybdenum oxides or nickel-molybdenum oxides and aluminum oxide. Hydropretreating employs a catalyst, while Shell's vapour desulphurization process uses a tungsten nickel sulphide catalyst.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT: The province of Alberta classifies this waste as hazardous since it contains more than 80 ppm cobalt and its compounds. There is a potential for nickel carbonyl to be present in some cases.

POTENTIAL HAZARDS: The spent catalyst may contain pyrophoric material and should be stored or shipped under a nitrogen blanket to avoid spontaneous combustion. Before entering a vessel that contained spent catalyst, the air space should be tested for the possible presence of nickel carbonyl and appropriate safeguards taken. Inhalation equipment should be used when removing catalysts from confined spaces or when working on a vessel that may contain catalyst dust.

PERSONAL PROTECTION:

- Wear full, impervious protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment is decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- Store in steel drums or containers.

HANDLING PRECAUTIONS:

- In confined spaces specific procedures must be followed.
- Minimize dust generation.

NAME OF WASTE: HYDROTREATER CATALYST (SPENT) **WASTE DATA SHEET NO.** II-21

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Subject to generator classification (see Part B, Section 2.3)

TYPE OF CARRIER: Provincially licensed closed truck or equivalent.

WAYBILLS REQUIRED: TDGA provincial or federal manifest dependent on waste classification.

LOADING/UNLOADING PRECAUTIONS:

Loading and transport under nitrogen blanket is advisable to avoid the possibility of spontaneous combustion.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND:

This study shows that 41% of the spent catalyst was landfilled, 53% was reclaimed for heavy metal content offsite and 6% went to Stablex. The decision to reclaim the heavy metals will depend upon the availability of a reclaimer and the transportation distances involved. Reclaiming seems to be popular in British Columbia, Quebec and Ontario. Leachate problems could result from sanitary landfilling.

DISPOSAL GUIDELINE:

Acceptable:
- Reclaiming
- Chemical fixation
- Secure landfill

Not Recommended:
- Sanitary landfill

SECTION 7 - SELECTED REFERENCES

1. Nelson, "Petroleum Refinery Engineering"

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WASTE DATA SHEET

NAME OF WASTE: MEROX CATALYST (SPENT)

(SYNONYM)

SHEET NO. II-22

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: PROCESS UNITS - Treatment of gasoline fractions, solvents, middle distillates, LPG, etc.

GENERAL DESCRIPTION: Caustic is used in varying strengths ranging from 5 to 25° Be to treat gasoline and middle distillate fractions, solvents, and LPG. Most of the spent caustic comes from the caustic washing of heavy catalytically cracked gasoline for mercaptan treatment. Acid oils removed by washing are usually reclaimed for making phenolic resins. The most common use of caustic is for removing small amounts of sulphides and mercaptans from petroleum products. Some plants mix the valuable acid oil (phenolic) containing caustic with sulphidic caustic to dispose of the latter, which has little or no commercial value. Caustic contaminated with Merox is often disposed of along with phenolic and sulphidic caustic.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: N/A

SOLUBILITY IN WATER: High

APPEARANCE: Beige to white

ODOUR: Mercaptan and sulphidic odour

CHEMICAL DATA: Phenolic spent caustic is composed of 10-25% acid oils (phenols, cresols) unreacted caustic soda, naphthenates, sulphides, mercaptans, hydrocarbons and water. Sulphidic caustic contains unreacted caustic soda, sulphides, mercaptans, naphthenates, hydrocarbons and water. Spent caustic from Merox treating will contain various iron compounds present in the Merox catalyst as well as caustic soda solution.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT: Hydrogen sulphide and odourous mercaptans.

POTENTIAL HAZARDS: All caustic solutions can cause skin burns and severe eye damage. Toxic gases such as H_2S and mercaptans may be evolved on contact with acids. Strong odours can result from improper handling. These can result in community complaints.

PERSONAL PROTECTION:
- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:
- Store in tanks lined with materials impervious to this waste.
- A dedicated storage tank is desirable.

HANDLING PRECAUTIONS:
- All piping may require stress relief.
- In confined spaces specific procedures must be followed. Use explosion-proof mechanical ventilation equipment and corrosion resistant ducting.
- Fire precautions must be taken since hydrocarbons are present.
- Strong odours can result from improper handling of this waste.
- Any contact with any acid can cause the release of gases such as mercaptans or H_2S.

NAME OF WASTE: MEROX CATALYST (SPENT) **WASTE DATA SHEET NO.** II-22

(SYNONYM)

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): 1824 **TDGR CLASSIFICATION:** 8, 9.2

TYPE OF CARRIER: Licensed provincial truck or rail car.

WAYBILLS REQUIRED: TDGA Provincial or Federal Manifest

LOADING/UNLOADING PRECAUTIONS: Extra care must be taken to ensure that leaks do not occur in transit. Personnel protection must be provided.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: In Canada the PACE questionnaire sent to petroleum plants prior to this Manual shows that 50% of the companies dispose of their waste caustic to a chemical company for acid oil reclamation. Some 17% goes to disposal wells while 33% goes to waste water treatment following neutralization under controlled conditions. See "Waste Water Treatment System". Care must be taken to introduce the neutralized caustic into the treatment system at a controlled rate. Dumping can have serious effects on the bacteria population of a biotreater. Raising the pH of the waste water can also seriously affect oil/water separation.

One refinery reports off-site incineration for phenolic caustic. Another recycles spent sulphidic caustic to a pulp mill while another plant uses it to adjust the pH of desalter water.

DISPOSAL GUIDELINE:

Acceptable:

- Reclamation to a chemical plant
- Re-use by a pulp mill
- Disposal wells
- Desalter pH adjustment (recycle)
- Neutralization with acid or flue gas before injection to waste water treatment
- Controlled injection to waste water treatment plant, as dictated by effluent quality limits

Not Recommended:

- Direct uncontrolled injection to a waste water treatment plant
- Sanitary landfill

SECTION 7 - SELECTED REFERENCES

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WASTE DATA SHEET

NAME OF WASTE: COPPER CHLORIDE CATALYST (SPENT)

(SYNONYM)

SHEET NO. II-23

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: PROCESS UNITS - Copper Chloride Sweetening Process

GENERAL DESCRIPTION: Copper chloride is used to sweeten light products such as solvents and naphthas. It is usually used as a fixed bed impregnated on a carrier such as fuller's earth. Eventually the catalyst bed loses its activity and must be discarded.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: N/A

APPEARANCE: Blue-green

SOLUBILITY IN WATER: Fairly high

ODOUR: Predominant odour comes from hydrocarbons being treated, however, partially treated products can smell strongly of mercaptans.

CHEMICAL DATA: Waste consists of $CuCl_2$, CuCl, fuller's earth, HCl and H_2O

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

This waste should be considered as hazardous due to the presence of copper salts, hydrochloric acid, mercaptans and hydrocarbons.

POTENTIAL HAZARDS

None likely.

PERSONAL PROTECTION:

- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- Store in lined vessels only and never in steel or concrete containers.
- A dedicated storage tank is desirable.

HANDLING PRECAUTIONS:

- In confined spaces specific procedures should be followed.
- Special care should be taken to prevent fires during removal from the vessels.
- Prevent leaching of this waste sludge or the decontamination "washings" into the subsurface waters.
- Avoid dust generation.

NAME OF WASTE: COPPER CHLORIDE CATALYST (SPENT) **WASTE DATA SHEET NO.** II-23

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Subject to generator classification (See Part B, Section 2.3)

TYPE OF CARRIER: Licensed provincial truck or tank car

WAYBILLS REQUIRED: TDGA Provincial or Federal Manifest

LOADING/UNLOADING PRECAUTIONS: Extreme care should be taken not to spill this material as it can be picked up on footwear and tracked into homes, cars and buildings. Bags used for disposal should be sealed and carefully handled.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: Copper chloride sweetening for the catalytic conversion of mercaptans and disulphides is falling to disuse with the advent of newer processes. When the copper chloride can no longer be regenerated with oxygen and the active cupric from the sweetening process stops, the catalyst is spent. Usually the catalyst is removed manually from the towers, put into special bags and taken to landfill.

DISPOSAL GUIDELINE:

Acceptable: - Secure landfill

Not Recommended:
- Sanitary landfill
- Landfarming

SECTION 7 - SELECTED REFERENCES

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WASTE DATA SHEET

NAME OF WASTE: CLAUS PLANT CATALYST (SPENT)

(SYNONYM) (SPENT SULPHUR PLANT CATALYST)

SHEET NO. II-24

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Process Units - Sulphur Recovery Plant

GENERAL DESCRIPTION: The Claus Sulphur Recovery Process utilizes a two or three stage reactor, which uses a catalyst to convert the unreacted H_2S with SO_2 to produce sulphur and water vapour. The catalyst is typically activated alumina.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: 3.8

SOLUBILITY IN WATER: Nil

APPEARANCE: Gray-white

ODOUR: None

CHEMICAL DATA: Hydrated alumina of the formula $Al_2O_3 \times H_2O$.
May contain a trace to 4% TiO_2 also selenium, depending on source.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

Selenium compounds possibly present which are considered hazardous by Alberta Environment because of persistence and bioaccumulative effects.
H_2S.

POTENTIAL HAZARDS

Possibly H_2S exposure.

PERSONAL PROTECTION:

- Eye protection shall be worn.
- Approved respiratory protection appropriate to the health hazards identified shall be worn.
- Encourage good personal hygiene.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- Store in covered containers.

HANDLING PRECAUTIONS:

- In confined spaces specific procedures must be followed.
- Minimize dust generation.

NAME OF WASTE: CLAUS PLANT CATALYST (SPENT) **WASTE DATA SHEET NO.** II-24

(SYNONYM): (SPENT SULPHUR PLANT CATALYST)

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Generator to classify waste (see Part B, Section 2.3)

TYPE OF CARRIER: Licensed provincial carrier or rail car.

WAYBILLS REQUIRED: TDGA Provincial or Federal manifest depending on classification

LOADING/UNLOADING PRECAUTIONS:

Ensure truck is properly enclosed or covered to avoid dust during transit.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: Current disposal practice in Canada is 100% sanitary landfill.

DISPOSAL GUIDELINE:

Acceptable: - Sanitary Landfill

SECTION 7 - SELECTED REFERENCES

1. Manual on Disposal of Refinery Waste, American Petroleum Institute
2. 1982 Refinery Solid Wastes Survey by API, prepared by Environmental Resources Management Inc.

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PACE

WASTE DATA SHEET

NAME OF WASTE: HF ACID SOLUBLE POLYMER

(SYNONYM) (HF POLYMER)

SHEET NO. II-25

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Process Units - Hydrofluoric Acid Alkylation Unit

GENERAL DESCRIPTION: During the alkylation process small volumes of a polymer may be formed and must be removed from the system. These volumes are generally less than one barrel per day for an average size unit. Universal Oil Products now market a retrofit system which eliminates the polymer formation in the process.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: 0.8 - 0.9

SOLUBILITY IN WATER: Low

APPEARANCE: Dark colour

ODOUR: Hydrocarbon

CHEMICAL DATA:

Consists of a polymer by-product. May contain small quantities of hydrofluoric acid.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

Hydrofluoric acid may be present.

POTENTIAL HAZARDS:

Hydrofluoric acid is a highly corrosive material.

PERSONAL PROTECTION:

- As long as the polymer is handled in a totally sealed enclosed system no additional personal protection is required. However, if there is any danger of release of hydrofluoric acid the personal protection described under Sheet II-4 must be followed.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- Store in tanks lined with materials impervious to this waste.
- A dedicated storage tank is desirable.

HANDLING PRECAUTIONS:

- Care must be taken in separating the polymer layer from the acid layer.
- In confined spaces specific procedures must be followed. Use explosion-proof mechanical ventilation equipment and corrosion resistant ducting.

NAME OF WASTE: HF ACID SOLUBLE POLYMER **WASTE DATA SHEET NO.** II-25

(SYNONYM): (HF POLYMER)

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Subject to generator classification (see Part B, Section 2.3)

TYPE OF CARRIER: Provincially licensed carrier having storage compartment designed with special alloys such as monel that are resistant to aqueous HF attack.

WAYBILLS REQUIRED: TDGA Provincial or Federal manifest dependent on waste classification.

LOADING/UNLOADING PRECAUTIONS: Ensure carrier tankage has appropriate aqueous HF acid resistant metallurgy with proper functioning seals. Protective clothing to provide eye and skin protection must be worn during loading or unloading operations.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: The current study shows that 50% of the plants faced with this problem use some form of on-site recycling, 16% incinerate and 16% send it to off-site landfill. The ideal approach is to retrofit the process to eliminate the polymer formation at the source.

DISPOSAL GUIDELINE:

Acceptable:
- Retrofit process and eliminate at source
- Lime neutralization and incineration
- Waste water treatment system

Not Recommended:
- Sanitary landfill

SECTION 7 - SELECTED REFERENCES

1. Contact U.O.P. Des Plaines, Illinois for details of the retrofit process.

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PART A

WASTE DATA SHEET (WDS) INDEX

CODE III - UTILITY PLANT WASTES

WDS NO.	NAME OF WASTE	SYNONYM	DATE ISSUED/ REVISED
III-1	Cooling Tower Sludge		November 1986
III-2	Lime Sludge	BFW Sludge	November 1986
III-3	Anthracite Filters	Multi-media Filters	November 1986
III-4	Spent Zeolite Resins	Ion-exchange Resins	November 1986
III-5	Sand from Filters		November 1986
III-6	Ion Exchange Regenerant		November 1986

PACE

WASTE DATA SHEET

NAME OF WASTE: COOLING TOWER SLUDGE

(SYNONYM)

SHEET NO. III-1

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Utility Plant - Cooling Water System

GENERAL DESCRIPTION: Solids are found in circulating cooling water and originate from a number of sources. Predominantly they arise from the interaction of the treatment chemicals, solids in the raw intake water and airborne particulates that enter the cooling towers. These solids over time settle out in the basins under the circulating cooling towers and must be cleaned out periodically.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: 1.05 - 1.15

SOLUBILITY IN WATER: Nil

APPEARANCE: Pale, beige color, slimy appearance

ODOUR: No predominant odour

CHEMICAL DATA: Chemical composition of cooling tower sludges is typically as follows:

Oil - Nil
Solids - 75-90%
Water - 10-25%

Heavy Metals - Cr - 10-8501 ppm(w)
Zn - 1-1090 ppm(w)
Others - Trace

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT: A range of heavy metals are contained in cooling tower sludges, although chromium and zinc tend to predominate, depending on the chemical treatment package used. Although cooling tower sludges are not listed as hazardous wastes by either EPA or TDGR, the waste should be considered as hazardous.

POTENTIAL HAZARDS: Using the EPA hazard criteria, samples of these sludges were found to be toxic and corrosive.

PERSONAL PROTECTION:

- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- Store in steel tanks or concrete pits.

HANDLING PRECAUTIONS:

- Sludges are often slurried up using water hoses and excessive splashing should be avoided.
- Prevent leaching of this waste sludge or the decontamination "washings" into the subsurface waters.

NAME OF WASTE: COOLING TOWER SLUDGE **WASTE DATA SHEET NO.** III-1

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Subject to generator classification (see Part B, Section 2.3)

TYPE OF CARRIER: Provincially certified vacuum or covered truck or tank car.

WAYBILLS REQUIRED: Transportation of Dangerous Goods Provincial or Federal Manifest.

LOADING/UNLOADING PRECAUTIONS:

Normal precautions to be taken to ensure that leakage in transit will not occur.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND:

Cooling water treatment often requires the use of several chemicals such as chlorine, sulphuric acid, algaecides, fungacides, chromium and zinc compounds along with phosphates. Cooling tower sludges contain a broad chemical mix. Chromium has a potential for being toxic in the environment, such that many petroleum plants have evaluated non-chromate systems with varying degrees of success. The cost of these non-chromate systems is higher and their effectiveness as a corrosion inhibitor is still in question. As a result, sludges from cooling towers will require serious attention.

In Canada and the United States approximately one third of the sludges are disposed of on land while the remainder goes to landfill.

DISPOSAL GUIDELINE:

Acceptable:
- Chemical Fixation
- Chromate Recovery
- Secure Landfill

Not Recommended:
- Land Treatment (Landfarming)
- Sanitary Landfill

SECTION 7 - SELECTED REFERENCES

1. PACE Report No. 81-5A "Landspreading of Sludges at Canadian Petroleum Facilities."

2. American Petroleum Institute "1982 Refinery Solid Waste Survey" by Environmental Resources Management Inc., West Chester, Pennsylvania, U.S.A. (zip code 19380).

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PACE

WASTE DATA SHEET

NAME OF WASTE: LIME SLUDGE

(SYNONYM)

SHEET NO. III-2

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Utility Plant - Boiler Feed Water

GENERAL DESCRIPTION: Hydrated lime is frequently used either as a first stage or as the only step in softening boiler feed water. The heavy sludge produced in the softening operation settles in the bottom of the cone shaped softener vessel and is blown down periodically into a blow down tank at which point it becomes a disposal problem.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: 1 - 1.1

SOLUBILITY IN WATER: Low

APPEARANCE: White

ODOUR: None

CHEMICAL DATA: The following typical characteristics have been reported by PACE:

	Range	Average
Water	5 - 95%	60%
Solids	5 - 95%	40%

The solids portion consists of $CaCO_3$, $Mg(OH)_2$ and unreacted lime hydrate.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

Unreacted lime.

POTENTIAL HAZARDS:

Direct contact with the skin or eyes can cause caustic burns.

PERSONAL PROTECTION:

- Eye and facial protection shall be worn.
- Wear full impervious protective apparel such as gloves, footwear, coveralls, etc.
- Encourage good personal hygiene and decontaminate all protective equipment after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS: The sludge may be blown down into a nearby lime sludge pit in order to cool the water phase, or it may be blown down directly into a lime sludge holding pond.

HANDLING PRECAUTIONS:

- All contact with oil during rundown should be avoided. Such contact will produce a gooey mixture that will plug equipment.
- Prevent the direct untreated release of this waste product or decontamination "washings" into the subsurface waters.

NAME OF WASTE: LIME SLUDGE **WASTE DATA SHEET NO.** III-2

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Subject to generator classification (see Part B, Section 2.3)

TYPE OF CARRIER: Provincially certified carrier - closed truck.

WAYBILLS REQUIRED: Transportation of Dangerous Goods Provincial or Federal Manifest.

LOADING/UNLOADING PRECAUTIONS:

Normal precautions to avoid waste leakage or spill in transit. Personnel protection outlined in Section 4 of this Waste Data Sheet should be followed.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND:

PACE reports that in 1980, 72% of this sludge was landfilled, 27% landfarmed (probably for soil pH adjustment), and 1% was returned to the river. The current study shows that in 1985 72% was landfilled, 21% landfarmed and 7% was sent to a local cement plant for reuse. The quantities of lime sludge are large. In 1980 some 6.9×10^6 Kg (15.2×10^6 lbs) were disposed of. In designing a holding pond or concrete basin, sufficient storage must be provided for the winter months. This may require duplicate basins.

DISPOSAL GUIDELINE:

Acceptable:
- Reuse in cement plant
- Sanitary Landfill
- Landfarming (for pH adjustment)

Not Recommended:
- Discharge to Waste Water Treatment System
- Direct discharge to river or lake
- Discharge to biotreater

SECTION 7 - SELECTED REFERENCES

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PACE

WASTE DATA SHEET

NAME OF WASTE: ANTHRACITE FILTERS

(SYNONYM)

SHEET NO. III-3

DATE 0

REV'N NO. November 1986

SECTION 1 - WASTE INFORMATION

SOURCE: Utility Plant - Boiler Feed Water

GENERAL DESCRIPTION: Many boiler feed water treatment systems employ filters following treatment of the water with lime hydrate to remove suspended solids. While usually referred to as anthracite filters it is a common practice to use other media such as sand, garnet and magnetite. The total bed depth usually varies between 38 and 76 cm (15 and 30 inches). Backwashing at 3 to 5 times the design flow rate at timed intervals can restore the bed activity but eventually the bed must be replaced.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: N/A

SOLUBILITY IN WATER: Nil

APPEARANCE: Black or gray

ODOUR: None

CHEMICAL DATA: Anthracite coal normally contains 85%+ carbon, less than 2% sulphur and the remainder ash. The suspended solids on the surface will be mainly $CaCO_3$ and $Mg(OH)_2$.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

Normally none.

POTENTIAL HAZARDS:

None likely.

PERSONAL PROTECTION:

- Avoid direct or prolonged skin contact.
- Use normal, good personal hygiene.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- No special storage method.

HANDLING PRECAUTIONS:

- Normal precautions only.

NAME OF WASTE: ANTHRACITE FILTERS **WASTE DATA SHEET NO.** III-3

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Subject to generator classification (see Part B, Section 2.3)

TYPE OF CARRIER: Licensed truck or rail car.

WAYBILLS REQUIRED: TDGA Provincial or Federal manifest depending on hazard classification.

LOADING/UNLOADING PRECAUTIONS:

Normal precautions to avoid spilling in transit.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND:

This survey shows that 86% of anthracite filter media is landfilled and the remainder goes to land treatment.

DISPOSAL GUIDELINE:

Acceptable:
- Sanitary landfill
- Incineration

Not Recommended:
- Land Treatment (Landfarming)

SECTION 7 - SELECTED REFERENCES

1. Betz "Handbook of Industrial Water Conditioning" - 8th edition.

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PACE

WASTE DATA SHEET

NAME OF WASTE: SPENT ZEOLITE RESINS

(SYNONYM) (ION-EXCHANGE RESINS)

SHEET NO. III-4

DATE 0

REV'N NO. November 1986

SECTION 1 - WASTE INFORMATION

SOURCE: Utility Plant - Boiler Feed Water

GENERAL DESCRIPTION: The term zeolite is used to describe a synthetic or naturally occuring cation exchange resin used to remove calcium and magnesium ions from raw boiler feedwater, replacing them with the more soluble sodium ion. Anion resins are used to remove the anionic materials. Eventually, after a large number of these regenerations, these resins must be replaced.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: N/A

SOLUBILITY IN WATER: Nil

APPEARANCE: Beige

ODOUR: None

CHEMICAL DATA:

Cationic Resins - Sulphonated styrene divinylbenzene or carboxylic based resins.

Anionic Resins - Polystyrene divinylbenzene.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

None.

POTENTIAL HAZARDS:

None.

PERSONAL PROTECTION:

Use normal good personal hygiene.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- No special methods.

HANDLING PRECAUTIONS:

- No special precautions.

NAME OF WASTE: SPENT ZEOLITE RESINS **WASTE DATA SHEET NO.** III-4

(SYNONYM): (ION-EXCHANGE RESINS)

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Subject to generator classification (see Part B, Section 2.3)

TYPE OF CARRIER: Licensed truck or rail car.

WAYBILLS REQUIRED: TDGA provincial or federal manifest as determined by classification.

LOADING/UNLOADING PRECAUTIONS:

Normal precautions as with inert solid materials.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND:

This study shows that all of the zeolite resins (spent) are disposed of either to sanitary landfill (78%) or land treatment (16%). One plant reuses the resins off-site.

DISPOSAL GUIDELINE:

Acceptable: - Sanitary or secure landfill

Not Recommended: - Land treatment

SECTION 7 - SELECTED REFERENCES

1. Betz "Handbook of Industrial Water Conditioning" - 8th Edition.

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PACE

WASTE DATA SHEET

NAME OF WASTE: SAND FROM FILTERS
(SYNONYM)

SHEET NO. III-5
DATE November 1986
REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Utility Plant - Process Units

- Filters used prior to biotreatment
- Side stream filters for cooling towers
- For removing traces of water from kerosene
- Multi-media anthracite filters

GENERAL DESCRIPTION: Sand filters can remove suspended solids and oil from waste streams at fairly high rates of flow. They can also resolve certain types of emulsions if the emulsion is caused by fine suspended material. The effective filtering area is only the top 5 to 100 cm according to Betz. Except in hydrocarbon service, it is customary to backwash the sand beds at high flow rates in the opposite direction to the normal flow. The suspended solids are washed into a concrete or steel vessel for settling and water removal.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY:

SOLUBILITY IN WATER: Nil

APPEARANCE: Brownish-black

ODOUR: Depends on service of filter

CHEMICAL DATA:

Will consist of sand plus hydrocarbons depending on service of the filter.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT: Sand from multi-media filters used on boiler feedwater pose no environmental problem because the contaminants are basically inert. Sidestream filters from cooling towers may contain chromium/zinc compounds depending on the type of water treatment used. Sand that has been used for filtering benzene, toluene and other chemicals must be handled with care.

POTENTIAL HAZARDS: Prolonged or repeated inhalation of silica (sand) can cause respiratory disease.

PERSONAL PROTECTION:

- Use normal, good personal hygiene.
- Approved respiratory protection appropriate for silica.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- Steel or concrete vessels.

HANDLING PRECAUTIONS:

- In confined areas specific procedures must be followed. Where required, mechanical ventilation equipment shall be explosion-proof.
- Observe strict fire precautions where volatile hydrocarbons are present.

NAME OF WASTE: SAND FROM FILTERS **WASTE DATA SHEET NO.** III-5

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted. **TDGR CLASSIFICATION:** Subject to generator classification (see Part B, Section 2.3)

TYPE OF CARRIER: Licensed truck or rail car.

WAYBILLS REQUIRED: Transportation of Dangerous Goods Provincial or Federal Manifest.

LOADING/UNLOADING PRECAUTIONS: Employees working inside of towers which have been in contact with benzene, toluene and other chemicals must wear inhalation equipment while working inside the vessel.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: This survey shows that 55% of the waste sand is landfilled and the remainder is landfarmed. If the sand was used to filter benzene, toluene or some other chemical which biodegrade slowly, special care should be taken to keep the loading per acre low if landfarming is the treatment method used.

DISPOSAL GUIDELINE:

Acceptable:
- Landfarm
- Secure landfill
- Sanitary landfill (if sand contains no hydrocarbons or metals)

Not Recommended:
- Spreading on roads

SECTION 7 - SELECTED REFERENCES

1. Betz Handbook of Industrial Water Conditioning, 8th Edition.

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WASTE DATA SHEET

NAME OF WASTE: ION EXCHANGE REGENERANT

(SYNONYM)

SHEET NO. III-6

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: UTILITY PLANT - Boiler Feed Water Treatment

GENERAL DESCRIPTION: Zeolite softeners used in removing hardness from boiler feed water must be regenerated with a concentrated solution of sodium chloride. The regenerant must be discarded.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: 1.0 - 1.1

SOLUBILITY IN WATER: High

APPEARANCE: White to gray

ODOUR: None

CHEMICAL DATA: Liquid consists of water, unreacted sodium chloride as well as calcium and magnesium chloride removed from the resins.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

None in particular.

POTENTIAL HAZARDS: The main hazard is to the waste water treatment system. If a bio-treater is part of the system, a sudden increase in the salinity of the biomass can shock the bacteria and decrease their activity. If the release is gradual, the bacteria should have time to adapt to their new environment and no serious harm should result.

PERSONAL PROTECTION:

- Use normal, good personal hygiene.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- Storage in lined tanks is preferred.

HANDLING PRECAUTIONS:

- No special precautions.

NAME OF WASTE: ION EXCHANGE REGENERANT **WASTE DATA SHEET NO.** III-6

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Subject to generator classification (See Part B, Section 2.3)

TYPE OF CARRIER: Licensed truck or rail car

WAYBILLS REQUIRED: TDGA Provincial or Federal Manifest

LOADING/UNLOADING PRECAUTIONS: Follow normal precautions required against spills or leaks in transit.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: The current practice in Canada is to dispose of this liquid into the wastewater treatment system via the sewer system.

DISPOSAL GUIDELINE:

Acceptable: - Waste water treatment

Not Recommended: - Land Treatment (Landfarming)

SECTION 7 - SELECTED REFERENCES

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PART A

WASTE DATA SHEET (WDS) INDEX

CODE IV - WASTE WATER TREATMENT PLANT

WDS NO.	NAME OF WASTE	SYNONYM	DATE ISSUED/ REVISED
IV-1	Gravity Separator Sludge	API, CPI, PPI Sludge	November 1986
IV-2	Dissolved Air Flotation Sludge Induced Air Flotation Sludge	DAF/IAF Float Sludge	November 1986
IV-3	Biotreater Sludge	Biosludge	November 1986
IV-4	Storm Pond Silt		November 1986
IV-5	Sump Sludge	Oily Sludge	November 1986

PACE

WASTE DATA SHEET

NAME OF WASTE: GRAVITY SEPARATOR SLUDGES (API,CPI,PPI)*
(SYNONYM) (API, CPI, PPI SLUDGE)

* API - American Petroleum Institute - Design
CPI - Corrugated Plate Interceptor
PPI - Parallel Plate Interceptor

SHEET NO. IV-1
DATE November 1986
REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Waste Water Treatment Plant

GENERAL DESCRIPTION: Gravity separator sludge is formed from oil and suspended solids contained in oily waste waters that settle out in oily sumps, catch basins and gravity separators. The accumulation of these oily solids reduces the efficiency of the gravity separator and must therefore be removed periodically. The frequency of clean-out will vary from location to location depending on local conditions, with once every six months being about average.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: 1.05 - 1.2

SOLUBILITY IN WATER: Low

APPEARANCE: Black, oily, gel-like material.

ODOUR: Characteristic strong hydrocarbon odour.

CHEMICAL DATA: Chemical characteristics are highly variable and plant specific. The following are typical composition ranges reported by petroleum refineries:

Oil - 0 to 70% (average 16%)
Solids - 5 to 70% (average 32%)
Water - 0 to 95% (average 50%)

In addition, small amounts of heavy metals are contained in these sludges.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

- Heavy metals - Cr, As, Ba, Pb, Cd, Hg, Se, Zn
- Light aromatic hydrocarbons
- Polynuclear aromatics

POTENTIAL HAZARDS: Gravity separator sludges are classified as hazardous under TDGA and certain provincial regulations. Using U.S. EPA criteria some gravity separator sludges have been found to be (1) ignitable, (2) reactive, and (3) toxic.
In considering disposal methods, the heavy metal fractions are susceptible to leaching out and contaminating soil and groundwater especially when acidic soil conditions are present.

PERSONAL PROTECTION:

- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment is decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- May be stored in steel tanks, concrete basins, or lined pits.
- Avoid anaerobic storage conditions since sulphide odours may evolve.

HANDLING PRECAUTIONS:

- In confined spaces specific procedures must be followed. Use explosion-proof mechanical ventilation equipment.
- Prevent leaching of this waste sludge or the decontamination "washings" into the subsurface waters.
- Observe fire precaution regulations.

NAME OF WASTE: GRAVITY SEPARATOR SLUDGE **WASTE DATA SHEET NO.** IV-1

(SYNONYM): (API, CPI, PPI SLUDGE)

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): 3045 **TDGR CLASSIFICATION:** 3.1, 6.1

TYPE OF CARRIER: Provincially certified carrier such as vacuum truck or enclosed truck or tank car.

WAYBILLS REQUIRED: Transportation of Dangerous Goods Provincial or Federal Manifest.

LOADING/UNLOADING PRECAUTIONS: Care should be taken in trucking sludge to a waste site. All vehicles should be checked for leakage and be properly sealed prior to transport. Use of open top trucks is not recommended as they present a spill hazard in the event of sudden stops.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND:

There are a number of treatment and disposal options available to plant operators. Industry surveys conducted by PACE and API indicate that current practice includes land-treatment, incineration, recycling sludges to a Coker unit (where available), and land-filling. Before considering these options a hazardous chemical analysis on the sludge and the leachate should be carried out.
The oil content of these sludges (16% ave.) is generally too low to make oil recovery an attractive option.
Sanitary landfill sites are not a good repository for these materials as the possibility of leachate contaminating groundwater always exists. On-site landfill (non-secure) can be very costly to clean up once environmental contamination results.

DISPOSAL GUIDELINE:

Acceptable:
- Land treatment (Landfarming)
- Recycle to Coking Unit
- Approved industrial incineration
- Secure landfill

Not Recommended:
- Sanitary landfill
- Open pit dumping
- Open pit burning
- Road spreading

SECTION 7 - SELECTED REFERENCES

1. PACE Report No. 81-5A "Landspreading of Sludges at Canadian Petroleum Facilities", December 1981.

2. American Petroleum Institute "1982 Refinery Solid Waste Survey" by Environmental Resources Management Inc., West Chester, Pennsylvania, U.S.A. (zip code 19380).

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PACE

WASTE DATA SHEET

NAME OF WASTE: INDUCED AND DISSOLVED AIR FLOTATION SLUDGE

(SYNONYM) (IAF/DAF FLOAT SLUDGE)

SHEET NO. IV-2

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Waste Water Treatment Plant

GENERAL DESCRIPTION: IAF and DAF are normally located downstream of an API Separator to reduce suspended solids and non-emulsified oil from the process water. Light hydrocarbons and dissolved gases are also removed. Chemical additives such as alum, ferric chloride, lime or polyelectrolytes are usually used to improve treatment efficiency. Use of IAF or DAF ahead of a biotreater improves the efficiency of the latter. The scum or float is removed from these units by a scraper or paddle.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: 1 - 1.2

SOLUBILITY IN WATER: Low

APPEARANCE: Beige to black

ODOUR: Oily odour

CHEMICAL DATA: The scum or float consists typically of; Water - 75-96%; Solids - 0-20%; and Oil - 2-5%. Heavy metals such as Cr, As, Ba, Cd, Hg, Se, Ag and Zn may be present. Pb levels were found to range from 1-290 mg/kg (median 17.5) total chromium 1-2500 mg/kg (median 42.5) based on wet sludge analysis.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

- Cr, As, Ba, Cd, Hg, Se, Ag, Pb and Hg. Lighter aromatic hydrocarbons such as benzene may be air stripped.

POTENTIAL HAZARDS: IAF and DAF sludges are "listed" wastes according to EPA because 12% failed the EP Toxicity Test, 18% the Ignitability Test and 13% the Reactivity Test. Inhalation of lighter aromatics can result in anesthesia among other systemic effects.

PERSONAL PROTECTION:

- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- May be stored in steel tanks or concrete basins.
- Avoid anaerobic storage conditions since sulphide odours may evolve.

HANDLING PRECAUTIONS:

- In confined spaces specific procedures must be followed. Use explosion-proof mechanical ventilation equipment.
- Prevent leaching of this waste sludge or the decontamination "washings" into the subsurface waters.

NAME OF WASTE: INDUCED AND DISSOLVED AIR FLOTATION SLUDGE

WASTE DATA SHEET NO. IV-2

(SYNONYM): (IAF/DAF FLOAT SLUDGE)

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): 3042

TDGR CLASSIFICATION: 3.1

TYPE OF CARRIER: Provincially licensed vacuum truck or equivalent

WAYBILLS REQUIRED: TDGA Provincial or Federal Manifest

LOADING/UNLOADING PRECAUTIONS: Normal precautions should be taken to avoid leakage in transit.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: According to PACE, IAF and DAF sludges were disposed of in Canada as follows in 1980: Landfill - 10.7%, API Separator - 49.8%, Incineration - 34.7%, Landfarm - 4.8%. Many refineries re-route the scum to the front end of an API separator. Apparently the suspended solids settle quite readily in the Separator and do not add significantly to the solids in the effluent. This practice seems to work well when coagulants such as polyelectrolytes are used. Caution should be exercised when alum, ferric chloride, etc. are used. The scum or float contains heavy metals and this should be taken into account when either incineration or landfarming is used for disposal.

DISPOSAL GUIDELINE:

Acceptable:
- Rerouting to API Separator
- Recycle to a Coker Unit
- Chemical fixation
- Land treatment (Landfarming)
- Secure landfill
- Incineration

Not Recommended:
- Sanitary landfill
- Rerouting directly to a biotreater
- Storage in unlined pits or ponds

SECTION 7 - SELECTED REFERENCES

1. PACE Report No. 81-5A "Landspreading of Sludges at Canadian Petroleum Facilities" December 1981.

2. American Petroleum Institute "1982 Refinery Solid Waste Survey" by Environmental Resources Management Inc., West Chester, Penn. 19380.

3. PACE Report No. 80-4 "Canadian Petroleum Refinery Industry Waste Survey" 1980.

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PACE

WASTE DATA SHEET

NAME OF WASTE: BIOTREATER SLUDGES

(SYNONYM) (BIOSLUDGE)

SHEET NO. IV-3

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: WASTE WATER TREATMENT PLANT

GENERAL DESCRIPTION: The activated sludge process for biological treatment produces a surplus of biosludge which must be removed periodically in order to maintain an equilibrium in the system.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: 1 - 1.05

SOLUBILITY IN WATER: Low

APPEARANCE: Grayish white to light brown

ODOUR: Characteristic sewage treatment plant odour.

CHEMICAL DATA: The composition of the sludge has been reported by PACE as follows:

	Range	Average
Water	85-98%	93.8
Solids	2-15%	6.0
Oil	0-1%	0.2

These sludges may also contain heavy metals such as Sb, As, Cd, Cr, Cu, Pb, Mn, Hq, Mo, Ni, and Se. Most of these metals were present in low concentrations but many were found at significant levels such as:

Cr -	6470 - 7350 mg/kg	Cu -	107 - 155 mg/kg	Pb	130 - 523 mg/kg
Ni -	56 - 272 " "	V -	124 - 248 " "	Zn	1400 -1730 " "

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

See Section 2 for heavy metals.

POTENTIAL HAZARDS: Biotreater sludge is a "non listed" waste, however it has the potential to be hazardous in site specific cases when the waste water contains high concentrations of heavy metals.

PERSONAL PROTECTION:

- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment is decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- May be stored in steel tanks, concrete basins, or lined pits.
- Avoid anaerobic storage conditions since sulphide odours may evolve.

HANDLING PRECAUTIONS:

- In confined spaces specific procedures must be followed.
- Prevent leaching of this waste sludge or the decontamination "washings" into the subsurface waters.
- Harmful bacteria could be present and additional precautions should be taken.

NAME OF WASTE: BIOTREATER SLUDGES **WASTE DATA SHEET NO.** IV-3

(SYNONYM): (BIOSLUDGE)

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Subject to generator classification (See Part B, Section 2.3)

TYPE OF CARRIER: Provincially licensed vacuum truck or equivalent carrier.

WAYBILLS REQUIRED: TDGA Provincial or Federal Manifest.

LOADING/UNLOADING PRECAUTIONS: Care should be taken in trucking raw sludge to a disposal or treatment area. Open trucks present a spill hazard in case of a sudden stop.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: The present surveys shows that 76% of biotreater sludge is landfarmed, 18% goes to landfill and the remainder recycled. If land treatment (landfarming) is used, heavy metals can build up in the soil and decrease bacterial activity. See landfarming.

Although data is limited, API states that a loading of 20 tons of dry solids per acre per year is realistic. The sludge may be applied as thickened or dewatered solids. Provided the soil is kept aerobic, dilute sludge may be applied. Once the sludge is incorporated into the soil, aeration is not essential. Some plants dewater or thicken the sludge before disposal while others subject it to aerobic digestion to remove the oxygen demand.

DISPOSAL GUIDELINE:

Acceptable:
- Incineration (scrubber)
- Chemical fixation
- Land treatment (Landfarming)
- Sanitary landfill (for dewatered sludge)

Not Recommended:
- Open pit burning of dewatered sludge.

SECTION 7 - SELECTED REFERENCES

1. API Manual on Disposal of Refinery Wastes - Volume on Solid Waste (1980).

2. PACE Report No. 81-5A "Landspreading of Sludges at Canadian Petroleum Facilities", 1981.

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WASTE DATA SHEET

NAME OF WASTE: STORM POND SILT

(SYNONYM)

SHEET NO. IV-4

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Waste Water Treatment Plant - Surface Water Collection Basins

GENERAL DESCRIPTION:

Fine particles of sand and oil are carried into the surface run-off systems from tank compounds, pipe runs, roads, roofs and paved areas of process units. The oily solids settle out and must be removed periodically.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: N/A

SOLUBILITY IN WATER: Low

APPEARANCE: Black

ODOUR: Oily

CHEMICAL DATA: Composition is variable and plant specific. The following ranges have been reported:

	Range	Average
Water	4 - 90%	35%
Solids	25 - 95%	58%
Oil	1 - 20%	7%

In addition, heavy metals may be present.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

- Heavy metals - Cr, Cu, Pb, Ni, Zn, V
- Phenols, oils

POTENTIAL HAZARDS: This is highly site-specific but the possible presence of toxic heavy metals and various hydrocarbons means that potential hazards may exist.

PERSONAL PROTECTION:

- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment is decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- Steel or concrete vessels.

HANDLING PRECAUTIONS:

- If material is stored in hot weather, sulphide odours may evolve.
- In confined spaces specific procedures must be followed.
- Prevent leaching of this waste sludge or the decontamination "washings" into the subsurface waters.

NAME OF WASTE: STORM POND SILT **WASTE DATA SHEET NO.** IV-4

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted. **TDGR CLASSIFICATION:** Subject to generator classification (see Part B, Section 2.3)

TYPE OF CARRIER: Licensed provincial truck or rail car.

WAYBILLS REQUIRED: Transportation of Dangerous Goods Federal or Provincial Manifest.

LOADING/UNLOADING PRECAUTIONS: An open box truck is not recommended because a sudden stop could result in a loss of cargo due to the thixotropic nature of this sludge.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: This survey shows that 60% is landfarmed and 40% landfilled in Canada. No disposal problem with landfarms should be encountered as long as precautions are taken with the heavy metals present. The amount of silt collected will depend to a very large degree upon the soil conditions. Many plants have been amazed at the amount of silt which can collect following a rain storm. This is particularly important if the soil is very light or if recent installations have disturbed the soil. Some thought must always be given in the pond design to a means of mechanical sludge removal.

DISPOSAL GUIDELINE:

Acceptable:
- Chemical fixation
- Landfarming
- Landfilling (sanitary or secure)

Not Recommended:
- Spreading on roads, dykes

SECTION 7 - SELECTED REFERENCES

1. PACE Report No. 81-5A "Landspreading of Sludges at Canadian Petroleum Facilities", 1981.

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WASTE DATA SHEET

NAME OF WASTE: SUMP SLUDGE

(SYNONYM) (OILY SLUDGE)

SHEET NO. IV-5

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Waste Water Treatment Plant

GENERAL DESCRIPTION: Oil and suspended solid wastes can originate from surface runoff, process effluent, tank dyke drainings and settle out in oily sumps, catch basins and gravity separator units. Periodically the settled sludge must be removed from these sumps, generally by vacuum truck, and properly disposed of.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: 1.05 - 1.2

SOLUBILITY IN WATER: Low

APPEARANCE: Black, oily

ODOUR: Characteristic hydrocarbon odour

CHEMICAL DATA: Chemical composition of sump sludge is highly variable from refinery to refinery. Typical compositional ranges are as follows:

	Range	Average
Oils	5 - 65	12
Solids	5 - 70	21
Water	0 - 85	67

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

- Heavy metals
- Light aromatic hydrocarbons
- Polynuclear aromatic hydrocarbons

POTENTIAL HAZARDS: Sump sludges are similar to API Separator Sludges which are classified as hazardous under TDGA and certain provincial regulations. Using EPA criteria certain sump sludges have been found to be ignitable, reactive and toxic. The heavy metal content of these sludges may be susceptible to leaching out and contamination of soil and groundwater may occur especially in the presence of acidic soils. Inhalation of light aromatics can result in anesthesia among other systemic effects.

PERSONAL PROTECTION:

- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment is decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- May be stored in steel vessels, concrete basins or lined pits.
- Avoid anaerobic conditions during storage as nuisance odours may develop.

HANDLING PRECAUTIONS:

- In confined spaces specific procedures must be followed. Use explosion-proof mechanical ventilation equipment.
- Observe fire prevention regulations.
- Prevent leaching of this waste sludge or the decontamination "washings" into the subsurface waters.

NAME OF WASTE: SUMP SLUDGE **WASTE DATA SHEET NO.** IV-5

(SYNONYM): (OILY SLUDGE)

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): 9377 **TDGR CLASSIFICATION:** 3.1, 6.1

TYPE OF CARRIER: Provincially certified carrier such as vacuum truck or closed truck or equivalent carrier.

WAYBILLS REQUIRED: TDGA Provincial or Federal manifest.

LOADING/UNLOADING PRECAUTIONS: Vehicle storage compartments should be checked for leakage and properly sealed as required use of open top transport is not recommended for these or similar sludges.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: There are a number of treatment and disposal options available to plant operators when dealing with sump sludges. Industry surveys conducted by PACE and API indicate that current practice includes landtreatment, incineration, recycling sludges to a Coker unit (where available), and landfilling. Before considering these options a hazardous chemical analysis on the sludge and the leachate should be carried out.
The oil content of these sludges (12% average) is generally too low to make oil recovery an attractive option.
Sanitary landfill sites are not a good repository for these materials as the possibility of leachate contaminating groundwater always exists. On-site landfill (non-secure) is not recommended as clean up can be very costly once environmental contamination takes place.

DISPOSAL GUIDELINE:

Acceptable:
- Land treatment (Landfarming)
- Recycle to Coking Unit
- Approved industrial incineration
- Secure landfill

Not Recommended:
- Sanitary landfill
- Open pit dumping
- Open pit burning
- Road spreading

SECTION 7 - SELECTED REFERENCES

1. PACE Report No. 81-5A "Landspreading of Sludges at Canadian Petroleum Facilities", December 1981.

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PART A

WASTE DATA SHEET (WDS) INDEX

CODE V - MISCELLANEOUS WASTES (Maintenance, Laboratory, Admin. Bldg.)

WDS NO.	NAME OF WASTE	SYNONYM	DATE ISSUED/ REVISED
V-1	Asbestos		November 1986
V-2	Refractory Brick	Fire Brick	November 1986
V-3	General Refuse		November 1986
V-4	Oil Contaminated Soil		November 1986
V-5	Used Drums		November 1986
V-6	Laboratory Spent Chemicals - Liquids		November 1986
V-7	Laboratory Spent Chemicals - Solids		November 1986
V-8	PCB Wastes	Askarel	November 1986
V-9	Demolition Scrap		November 1986
V-10	Heat Exchanger Cleanings - Solids		November 1986
V-11	Heat Exchanger Cleanings - Liquids		November 1986

PACE

WASTE DATA SHEET

NAME OF WASTE: ASBESTOS

(SYNONYM)

SHEET NO. V-1

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: MISCELLANEOUS - Maintenance, As an insulation for piping, vessels and machinery fireproofing.

GENERAL DESCRIPTION: Asbestos insulation was used for many years as a form of insulation in petroleum plants. Due to a better understanding of its hazardous nature, many plants are systematically replacing asbestos with some type of non-hazardous material.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: N/A

SOLUBILITY IN WATER: Nil

APPEARANCE: Gray-white

ODOUR: None

CHEMICAL DATA:

Mainly asbestos with a binder of some type.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT: Asbestos is a human carcinogen.

POTENTIAL HAZARDS: Avoid hazard situations by never allowing inhalation of asbestos fibres. Avoid creating dust by keeping asbestos-containing material wetted down. Do not spill.

PERSONAL PROTECTION:

- Wear full protective apparel such as gloves, footwear, hooded coveralls, etc. Tape sleeves and ankles and prevent entry around the neck.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the type of health hazard must be worn.
- Encourage good personal hygiene and decontaminate all personal protective equipment after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:
- All asbestos waste must be stored in properly labelled, sealed, polyethylene bags of adequate thickness.
- The label should meet the provincial Health and Safety requirements.

HANDLING PRECAUTIONS:
- Isolate and wet down the area where asbestos demolition is to take place.
- Limit the creation of new asbestos dust as waste materials are handled.
- Polyethylene sheeting on the floor of the work area will also minimize contamination.
- Decontaminate the work area after completion of the demolition operation.
- Unauthorized personnel should be prohibited from the work area during demolition.

NAME OF WASTE: ASBESTOS **WASTE DATA SHEET NO.** V-1

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): 2590 **TDGR CLASSIFICATION:** 9.1

TYPE OF CARRIER: Provincially licensed truck or rail car.

WAYBILLS REQUIRED: TDGA Provincial or Federal Manifest.

LOADING/UNLOADING PRECAUTIONS: The asbestos waste must be transported either in a compaction type haulage vehicle, an enclosed vehicle or in cardboard boxes totally covered with 6 mil polyethylene. Any loose asbestos or asbestos that is loose in a punctured container must be packaged immediately.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: The PACE survey which preceded this Manual shows that all waste asbestos in Canada is landfilled. In Ontario, Regulation 309 specifies that 125 centimetres (49 inches) of garbage or cover material must be placed over the bags of asbestos in order to avoid direct contact between compaction equipment and the plastic bags.

DISPOSAL GUIDELINE:

Acceptable:
- Secure landfill
- Approved sanitary landfill
- Chemical fixation

Not Recommended:
- Disposal of any type of loose asbestos in a landfill site of any kind.

SECTION 7 - SELECTED REFERENCES

1. Ontario MOE Regulation 175/83 made as an amendment to Regulation 309 under the Environmental Protection Act.

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WASTE DATA SHEET

NAME OF WASTE: REFRACTORY BRICK

(SYNONYM) (FIRE BRICK)

SHEET NO. V-2

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Miscellaneous - Process Units and Utilities Plant

GENERAL DESCRIPTION: Heaters and boilers are lined with refractory brick to resist the very high internal temperatures found in the combustion chambers. Due to a fire or simply wear and tear, this brick must be replaced.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY:

SOLUBILITY IN WATER: Nil

APPEARANCE: Buff coloured

ODOUR: None

CHEMICAL DATA: Refractory brick is usually composed of hydrous alumina silicate of the general type formula $Al_2O_3.2SiO_2.2H_2O$. Various types of fire brick are available depending upon their end use.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

Various heavy metals if liquid fuels such as pitch or bunker used in the heater, boiler or incinerator.

POTENTIAL HAZARDS: Skin and lung irritation could occur. Possible silica hazard (respiratory disease on prolonged or repeated exposure to dust).

PERSONAL PROTECTION:
- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- Steel or concrete vessels kept closed to reduce dust.

HANDLING PRECAUTIONS:

- Wet operations can reduce the liberation of free silica dust and other particulate.
- If the waste brick is crushed to reduce storage volume it should be done under controlled conditions.
- In confined spaces specific procedures must be followed.

NAME OF WASTE: REFRACTORY BRICK **WASTE DATA SHEET NO.** V-2

(SYNONYM): (FIRE BRICK)

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Subject to generator classification (see Part B, Section 2.3)

TYPE OF CARRIER: Licensed provincial carrier suitable for carrying rubble.

WAYBILLS REQUIRED: TDGA Provincial and Federal manifest required dependent on waste classification.

LOADING/UNLOADING PRECAUTIONS: If an open type truck is used, tarpaulins should be used to retain dust. Wetting down can help.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND:

This study shows that 100% of refractory brick is landfilled.

DISPOSAL GUIDELINE:

Acceptable:
- Secure landfill (if heavy metals present)
- Sanitary landfill (no heavy metals present)

Not Recommended:

SECTION 7 - SELECTED REFERENCES

1. Eshbach, "Handbook of Engineering Fundamentals"

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WASTE DATA SHEET

NAME OF WASTE: GENERAL REFUSE

(SYNONYM)

SHEET NO. V-3

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Miscellaneous - Various parts of plant

GENERAL DESCRIPTION:

General refuse consists of garbage, cardboard containers, rags, glass, paper, etc.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: N/A

SOLUBILITY IN WATER: Nil

APPEARANCE: N/A

ODOUR: Could be unpleasant in hot weather

CHEMICAL DATA: N/A

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

Could contain bagged asbestos but this must be segregated according to regulations.

POTENTIAL HAZARDS: Mainly from fire. Sulphidic iron scale from tanks could possibly start a fire spontaneously. Possibility that drums containing chemicals such as pesticides or herbicides have not been thoroughly rinsed.

PERSONAL PROTECTION:

- Workers should wear full clothing so that all exposed skin areas are protected.
- Eye protection should be worn at all times when handling such refuse.
- Good personal hygiene should be encouraged and clothing should be decontaminated if contact is made.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:
- Usually stored in dumpster buckets for pick-up by specially equipped trucks.

HANDLING PRECAUTIONS:

- The following material should be segregated and stored apart from general refuse: asbestos, waste oil, non-returnable steel drums (should be crushed), chemicals of any kind, PCB containing drums or equipment, acids or alkalis, and steel piping.
- Some of the waste may be flammable so care should be taken against fire.

NAME OF WASTE: GENERAL REFUSE **WASTE DATA SHEET NO.** V-3

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Subject to generator classification (see Part B, Section 2.3)

TYPE OF CARRIER: Provincially licensed carrier for general refuse.

WAYBILLS REQUIRED: TDGA provincial or federal manifest dependent on waste classification.

LOADING/UNLOADING PRECAUTIONS:

Normal safe loading and unloading precautions.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: The survey conducted prior to this manual showed that the amount of refuse per refinery is in the medium to large category with 100% landfilling. In 1980 PACE reported 27 x 10^6 Kg/year (60 x 10^6 lbs) of general refuse resulting from maintenance/shut-down operations. Of this waste, less than 0.1% was incinerated, the rest was landfilled. General refuse probably represents the most visible waste leaving a petroleum plant.

DISPOSAL GUIDELINE:

Acceptable:
- Sanitary landfill (segregated wastes)
- Controlled incineration

Not Recommended:
- Unsegregated refuse to landfill
- Open burning of combustibles

SECTION 7 - SELECTED REFERENCES

1. PACE Report No. 80-4 "Canadian Petroleum Refinery Industry Waste Survey", 1980.

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WASTE DATA SHEET

NAME OF WASTE: OIL CONTAMINATED SOIL

(SYNONYM)

SHEET NO. V-4

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Miscellaneous - Various parts of plant.

GENERAL DESCRIPTION: When an oil spill occurs it is customary to use sand to absorb the spill although other materials may be used. This oily soil must be disposed of.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: 1 - 3

SOLUBILITY IN WATER: Nil

APPEARANCE: Brown/black

ODOUR:

CHEMICAL DATA:

Soil will contain varying amounts of oil.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

Unlikely to be toxic unless aromatics such as benzene or some other hazardous chemical is shown to be present.

POTENTIAL HAZARDS: Specific to nature of oil spilled on soil.

PERSONAL PROTECTION:

- Unless the contaminant is known to be non-hazardous workers should wear protective clothing. The level of protection will be based upon the nature of the material identified.
- If an eye hazard is identified, eye or facial protection shall be worn.
- If an inhalation problem is identified, approved and appropriate respiratory protection must be worn.
- Encourage good personal hygiene.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS: Although steel or concrete vessels are usually adequate, individual storage will depend upon the nature of the spilled material.

HANDLING PRECAUTIONS:

- Precautions will vary with the nature of the spilled material - spilled materials should be analyzed.
- Non-sparking equipment should be used if volatile products are involved.
- Workers should take care not to slip on oily surfaces.

NAME OF WASTE: OIL CONTAMINATED SOIL **WASTE DATA SHEET NO.** V-4

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Subject to generator classification (see Part B, Section 2.3)

TYPE OF CARRIER: Licensed provincial carrier.

WAYBILLS REQUIRED: TDGA provincial or federal manifest required dependent on waste classification.

LOADING/UNLOADING PRECAUTIONS: Care needs to be taken to avoid fire since the oil is absorbed by the sand and is therefore easier to ignite.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND:

This study shows that 48% of contaminated soil is landfilled, 48% landfarmed and the remainder recycled on-site.

DISPOSAL GUIDELINE:

Acceptable:
- Land treatment (Landfarming)
- Secure landfill

Not Recommended:
- Spreading on dyked compounds
- Sanitary landfill

SECTION 7 - SELECTED REFERENCES

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WASTE DATA SHEET

NAME OF WASTE: USED DRUMS

(SYNONYM)

SHEET NO. V-5

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Miscellaneous - Various parts of plant

GENERAL DESCRIPTION: Drums are either of the returnable or non-returnable type and are used to bring chemicals and products into the plant as well as for shipment out.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: N/A

SOLUBILITY IN WATER: N/A

APPEARANCE: N/A

ODOUR: N/A

CHEMICAL DATA: N/A

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

Under Alberta legislation, drums (larger than 20 litres) containing a large number of specified chemicals are considered hazardous waste.

POTENTIAL HAZARDS:

The risk will depend upon the contents of the drum. Used drums should be treated as hazardous until proven otherwise.

PERSONAL PROTECTION:

- Workers handling drums containing chemicals, either full or empty, should be fully aware of the nature of the materials in the drums and the appropriate measures required to handle the material safely.
- If no information is available, skin and eye protection shall be worn.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS: Used drums should be taken to a central dry shelter and kept there until advised by the environmental engineer on how they are to be disposed of. They should not be left outdoors to collect rain and snow. Indoor shelter is recommended until disposal can be arranged.

HANDLING PRECAUTIONS:
- Indoor shelter is recommended until disposal can be arranged.
- Used drums should not be left at the place of use. Rinsing before storage is recommended in some cases but the advice of the Environmental Engineer should be followed.
- A cutting torch should never be used on any steel drum that contains any trace chemicals.

NAME OF WASTE: USED DRUMS **WASTE DATA SHEET NO.** V-5

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted

TDGR CLASSIFICATION: Subject to generator classification (see Part B, Section 2.3)

TYPE OF CARRIER: Licensed provincial carrier

WAYBILLS REQUIRED: TDGA Provincial or Federal manifest dependent on waste classification.

LOADING/UNLOADING PRECAUTIONS:

Avoid tipping or spilling drums unless they have been rinsed previously.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: This recent survey shows that only 24% of the plants report landfilling of their used non-returnable drums. The remainder send their drums to a reclaimer of some type. Regardless of whether the drums are to be reclaimed or not they should first be rinsed with water or solvent to remove the remaining chemicals. The rinsings should receive suitable treatment on advice of the environmental engineer. If the drums go back to the reclaimer for re-use, the owner should ensure that the nature and the implications of the chemicals remaining in the drum are fully understood.

DISPOSAL GUIDELINE:

Acceptable:
- Send drums to reclaimer (returnables)
- Rinse, crush and sell for scrap (non-returnables)
- Storage in dry shelter

Not Recommended:
- Disposal in sanitary landfill

SECTION 7 - SELECTED REFERENCES

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WASTE DATA SHEET

NAME OF WASTE: LABORATORY LIQUID WASTES

(SYNONYM)

SHEET NO. V-6

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Miscellaneous - Laboratory

GENERAL DESCRIPTION: A number of liquids are discarded from plant laboratories. These fall into three major categories; aqueous, non-aqueous and hazardous organic chemicals. The non-aqueous liquid wastes will contain petroleum fractions of various kinds. The aqueous portion consists of spent acids, alkalis and inorganic chemical solutions. The hazardous organic chemicals will contain such commonly used chemicals as benzene, acetone, carbon tetrachloride, methyl ethyl ketone, etc.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: 0.8 - 1.0 (non-aqueous)
1.0 - 1.2 (aqueous)
0.7 - 1.1 (hazardous)

SOLUBILITY IN WATER: Nil (non-aqueous)
Miscible (aqueous)

APPEARANCE: Usually clear

ODOUR: Strong hydrocarbon odour

CHEMICAL DATA:

Non-aqueous:	Petroleum fractions of all kinds.
Aqueous:	Acids, alkalis, inorganic chemical solutions used in test procedures
Hazardous:	Benzene, acetone, carbon tetrachloride, M.E.K. etc.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

Aqueous:	Acids, alkalis, cyanides
Hazardous:	Aromatic solvents such as benzene, acetone and carbon tetrachloride.
Non-aqueous:	Petroleum fractions may contain small amounts of hazardous chemicals.

POTENTIAL HAZARDS:

Aqueous:	Danger of skin or eye burns.
Hazardous:	Inhalation of fumes should be avoided. Consult data sheet for the specific materials involved..
Non-aqeuous:	Inhalation and skin contact should be avoided.

PERSONAL PROTECTION:

- A protective impervious apron and gloves shall be worn whenever any liquid laboratory waste is handled.
- Eye protection shall be worn whenever any liquid laboratory waste is handled.
- If vapours become a problem, approved respiratory protection appropriate to the identified health hazard must be worn.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS: Aqueous wastes in normal quantities can be stored in vented steel or lined tanks between pump outs. The same applies for non-aqueous and hazardous wastes. Avoid concrete vessels or piping for aqueous waste.

HANDLING PRECAUTIONS:

- Aqueous solutions - avoid skin contact. If it does occur, wash immediately with soap and water; Non-aqueous wastes - wash affected areas with soap and water; Hazardous chemicals - avoid skin contact and inhalation.
- Care must be taken to prevent reactions between various aqueous solutions with the attendant release of hydrogen sulphide, cyanogen, etc. Strong odours are a possibility. The holding vessel should be vented and the inlet to the tank submerged below the liquid level. Non-aqueous and hazardous wastes require vented storage to prevent gas emissions.

NAME OF WASTE: LABORATORY LIQUID WASTES **WASTE DATA SHEET NO.** V-6

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Subject to generator classification (see Part B, Section 2.3)

TYPE OF CARRIER: Licensed provincial carrier suitable for chemical transport.

WAYBILLS REQUIRED: TDGA Provincial or Federal manifest dependent on waste classification.

LOADING/UNLOADING PRECAUTIONS: Aqueous - Care should be taken to ensure that the metallurgy of the piping and other loading/unloading equipment is compatible with the solution to be handled; Non-aqueous - Normal precautions associated with flammable hydrocarbons; Hazardous Chemicals - Avoid spilling on ground as they could get into groundwater.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: The current study shows that 59% of the reporting plants send their laboratory waste liquids to the waste water treatment system, 29% are recycled (organics), 6% incinerated and 6% go to a disposal well (inorganics).

DISPOSAL GUIDELINE:

Acceptable: Aqueous: - To an enclosed vented settling tank with liquid effluent to waste water treatment system.

Non-aqueous, non-hazardous: - To an enclosed and vented holding tank for pump out and reprocessing.

Hazardous chemicals: - To a segregated vented holding tank for suitable treatment depending upon chemical composition.

Not Recommended: - A single collection system for aqueous, non-aqueous and hazardous chemicals all going to waste water treatment system.

SECTION 7 - SELECTED REFERENCES

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WASTE DATA SHEET

NAME OF WASTE: LABORATORY SOLID WASTES

(SYNONYM)

SHEET NO. V-7

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Miscellaneous - Laboratory

GENERAL DESCRIPTION:

Solid laboratory wastes consist of rags, containers of various kinds, garbage, dessicants, paper, cardboard, etc.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: N/A

SOLUBILITY IN WATER: Nil

APPEARANCE: Varies

ODOUR: N/A

CHEMICAL DATA: N/A

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

Depending upon contact with chemicals, toxic materials could be present.

POTENTIAL HAZARDS:

Containers not adequately rinsed could be hazardous.

PERSONAL PROTECTION:

- Wear protective gloves whenever any solid laboratory wastes are handled.
- Wear eye protection whenever any solid laboratory wastes are handled.
- Practice good personal hygiene.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- Steel bins are usually adequate however they should be enclosed to prevent odours and vermin access.

HANDLING PRECAUTIONS:

- Bins or buckets should be located well away from laboratory and signs should be posted to limit the types of materials which may be deposited.
- Care should be exercised since the waste may contain hazardous chemicals.

NAME OF WASTE: LABORATORY SOLID WASTES **WASTE DATA SHEET NO.** V-7

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted

TDGR CLASSIFICATION: Subject to generator classification (see Part B, Section 2.3)

TYPE OF CARRIER: Licensed provincial carrier suitable for chemical transport.

WAYBILLS REQUIRED: TDGA provincial or federal manifest dependent on waste classification.

LOADING/UNLOADING PRECAUTIONS:

Keep these wastes away from open flame.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND:

In Canada the recent survey shows that 100% of these wastes is landfilled. Laboratory wastes may be collected along with general plant refuse depending upon the distances involved. Old asbestos insulation should not be stored with this material.

DISPOSAL GUIDELINE:

Acceptable:
- Secure landfill

Not Recommended:
- Sanitary landfill
- Open dumping
- Open burning

SECTION 7 - SELECTED REFERENCES

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WASTE DATA SHEET

NAME OF WASTE: PCB WASTES

(SYNONYM) (ASKAREL)

SHEET NO. V-8

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Miscellaneous - Plant Electrical System or Processing

GENERAL DESCRIPTION: PCB wastes include any PCB liquid, PCB solid, PCB equipment or PCB packaging. PCB's are used in transformers, capacitors, hydraulic equipment, electro-magnets, vapour diffusion pumps and heat transfer equipment. The regulations respecting the handling, storage, use and disposal of PCB wastes are very strict. Responsibility for the management of PCB's is mainly under the jurisdiction of the provinces. However the federal government, under the Environmental Contaminants Act controls their use and sets limits on the amount which may be released into the environment in the course of certain activities.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: 1.0+

SOLUBILITY IN WATER: Nil

APPEARANCE: Crystal clear to yellow

ODOUR: Bitter smell

After use, PCB's may appear cloudy or darker in colour due to dirt, moisture, carbon particles due to arcing, etc.

CHEMICAL DATA: Formula $C_{12}H_{10-n}Cl_n$ where $n > 2$ (Federal definition). In Ontario the definition involves all chlorobiphenyls where $n \geq 1$. "Askarel" means commercial mixtures containing PCB's in excess of 30% by weight.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT: Chlorobiphenyls (PCB's)

POTENTIAL HAZARDS: PCB's are essentially non-biodegradable and can bioaccumulate in all types of life through the food chain and eventually to humans. PCB's can be absorbed through contact with the skin and inhalation of vapour. If PCB's get into a biotreater they will accumulate in the sludge and if this sludge is landfarmed they could potentially get into the food chain.

PERSONAL PROTECTION:
- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment is decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS: Liquid may be stored in sealed drums in secure indoor storage. Equipment such as empty transformers should be stored on existing premises or in a weatherproof shed. Storage facilities must comply with all federal and provincial environmental, occupational health and safety requirements as well as any municipal by-laws or codes. The storage building should have adequate ventilation of at least 6 air changes per hour. If indoor storage is not possible, outdoor storage may be used provided adequate precautions are taken to prevent or contain leakage. Precautions should be taken in the design of storage facilities to ensure spill containment, fire control and emergency response training for personnel are appropriate to the degree of hazard.

HANDLING PRECAUTIONS: Capacitors should be placed in 200 litre No.18 garage steel drums with a removable steel lid and a gasket made of nitrile rubber, cork or Teflon. The capacitors should be stored with their terminals up to prevent leakage. Leaking capaci-

NAME OF WASTE: PCB WASTES **WASTE DATA SHEET NO.** V-8

(SYNONYM): (ASKAREL)

HANDLING PRECAUTIONS CONT'D:
tors should be drained and enclosed in a heavy polyethylene bag before being placed into the drum. The voids should be filled with sawdust. Drums should be sealed and labelled. Capacitors too large for drums should be enclosed in heavy polyethylene bags and crated for transfer to storage. Small transformers, like capacitors, may be stored without draining. Large transformers should be drained into double lung steel drums. For on-site storage, a transformer need not be drained provided it is structurally sound and all drain valves, including cooling tubes, etc. are protected from damage. Wherever possible PCB's should be pumped rather than drained. Centrifugal pumps with stainless steel surfaces should be used. The shaft seal should be an external carbon ring type to avoid deterioration by PCB. Valves should be brass or stainless steel. Flexible metal hoses lined with Teflon or silicone polymers, as well as drip trays, should be employed.

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): 2315 **TDGR CLASSIFICATION:** 9.1, 9.2

TYPE OF CARRIER: Provincially approved carrier or equivalent.

WAYBILLS REQUIRED: TDGA provincial or federal manifest.

LOADING/UNLOADING PRECAUTIONS: If a piece of equipment such as a transformer containing PCB must be drained before moving, it will require a triple rinse with a solvent such as trichlorobenzene, kerosene, or fuel oil. Allow 18 hours or more following each filling for the solvent to reach the transformer core. The rinse solvent should be put into drums and labelled according to Environment Canada instructions. A protective crate should be built around the transformer to protect appurtenances. Routine handling should then be observed.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: Great care and strict observances of the rules are required when dealing with PCB's if serious problems are to be avoided later on. In all cases the guidance of the federal and/or provincial environmental agency should be sought. If the plant is fortunate enough to have a sheltered ventilated storage area available, then a record should be kept of monthly or more frequent inspections. Any leaks need to be drawn to the attention of plant management in writing. At present there are no approved disposal facilities for PCB's in Canada so secure storage until mobile disposal units or some other destruction technology becomes available is the only answer. The environmental engineer faced with a PCB problem should consult the references below for more details before taking action.

DISPOSAL GUIDELINE:

Acceptable:
- Secure indoor storage
- Secure outdoor storage

Not Recommended:
- Outdoor storage with no spill prevention or back-up recovery system

SECTION 7 - SELECTED REFERENCES

1. Environment Canada "National Manual for the Management of PCB Wastes", Ottawa K1A 1C8.

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WASTE DATA SHEET

NAME OF WASTE: DEMOLITION SCRAP

(SYNONYM)

SHEET NO. V-9

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: Miscellaneous

GENERAL DESCRIPTION: Demolition scrap results from the repairing, rebuilding or demolition of plant facilities. Several different types of scrap must be disposed of, namely steel, concrete, wood and brick.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: Varies

SOLUBILITY IN WATER: Nil

APPEARANCE: Varies

ODOUR: Usually none

CHEMICAL DATA: N/A

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT: Usually none unless materials have been in contact with hazardous substances. Scrap drums, for example, could be hazardous.

POTENTIAL HAZARDS: Where combustibles are concerned there is always the danger of fire.

PERSONAL PROTECTION:

- Protective clothing, safety shoes, gloves and eye shields should always be worn to guard against accidents.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

- Usually segregated and piled near source for pick-up.

HANDLING PRECAUTIONS:

- Sometimes necessary to wet down scrap to prevent dust problems.
- Highly hazardous materials, Pb/steel, HF/iron, etc., should be segregated and treated separately.

NAME OF WASTE: DEMOLITION SCRAP **WASTE DATA SHEET NO.** V-9

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): Unlisted **TDGR CLASSIFICATION:** Subject to generator classification (see Part B, Section 2.3)

TYPE OF CARRIER: Licensed provincial closed truck or equivalent carrier.

WAYBILLS REQUIRED: TDGA provincial or federal manifest dependent on waste classification.

LOADING/UNLOADING PRECAUTIONS:

Wet down and try to prevent dust problems. Dusty materials should be transported in covered or closed trucks.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND:

In 1980 PACE reported that 32 of the 37 refineries used an outside contractor for disposal of this type of waste. The tonnage for demolition scrap was included with that for other wastes. This study shows that 40% is landfilled and the remainder recycled or reclaimed, presumably the metal portion.

DISPOSAL GUIDELINE:

Acceptable:
- Sanitary landfill
- Reclaiming (metals)

Not Recommended:

SECTION 7 - SELECTED REFERENCES

1. PACE Report No. 80-4 "Canadian Petroleum Refining Industry Waste Survey", 1980.

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WASTE DATA SHEET

NAME OF WASTE: HEAT EXCHANGER CLEANINGS - SOLIDS

(SYNONYM)

SHEET NO. V-10

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: MISCELLANEOUS - Maintenance, Cleaning of heat exchangers

GENERAL DESCRIPTION: Solids and sludges are produced from the cleaning of heat exchangers by means of high pressure water and/or chemicals of various kinds.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: 1-3

SOLUBILITY IN WATER: Slight

APPEARANCE: Brown to black

ODOUR: No predominant odour

CHEMICAL DATA: Composition of sludges is typically as follows; Oil - 4.8%, Solids - 55.4%, Water - 42.8%. Heavy metals: Cr - 11-1600ppm(w), Pb - 25-1100ppm(w). May also contain acids and alkalis depending upon system used.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT: Depending upon the metallurgy of the exchanger and its process use, a number of heavy metals such as Cr, Pb, Ni, and Fe may be present.

POTENTIAL HAZARDS: Heat exchanger sludges are "listed" as hazardous wastes under EPA and therefore require special treatment. Using the EPA hazard criteria samples of these sludges were found to be toxic, ignitable, reactive or corrosive.

PERSONAL PROTECTION:
- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment is decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:
- Store corrosive sludges in lined tanks or vessels.
- Do not store acid sludges in concrete vessels.
- Other sludges may be stored in steel or lined tanks.

HANDLING PRECAUTIONS:
- In confined spaces specific procedures must be followed.
- Prevent leaching of this waste sludge or the decontamination "washings" into the subsurface waters.

NAME OF WASTE: HEAT EXCHANGER CLEANING - SOLIDS **WASTE DATA SHEET NO.** V-10

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): 3044 **TDGR CLASSIFICATION:** 6.1, 8

TYPE OF CARRIER: Licensed truck or rail car.

WAYBILLS REQUIRED: TDGA Provincial or Federal Manifest.

LOADING/UNLOADING PRECAUTIONS: Follow normal loading and unloading precautions ensuring that personnel are adequately protected against skin and eye contact. Ensure carrier is properly sealed against leakage or transit spills.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: It is customary to remove fouled exchanger bundles and to clean them with high pressure water either at the site or preferably in a special area set aside for this purpose. Sometimes the exchanger is filled with inhibited acid or alkali and soaked before releasing the cleaning liquid. The nature of the cleaning fluid will depend upon the chemical composition of the deposit to be removed. Lime deposits for example are most easily removed by inhibited acid.

In Canada, 42% of the sludges are landfilled and the remainder landfarmed.

DISPOSAL GUIDELINE:

Acceptable:
- Secure landfill
- Chemical fixation

Not Recommended:
- Waste water treatment system
- Land treatment (Landfarming)

SECTION 7 - SELECTED REFERENCES

1. American Petroleum Institute "1982 Refinery Solid Waste Survey" by Environmental Resource Management Inc., West Chester, Penn. 19380.

NOTE: This Waste Data Sheet is based on the best available information at time of publication. If additional pertinent information becomes available to the reader, we would appreciate having it brought to our attention at the following address: PACE, 1202-275 Slater Street, OTTAWA, Ont. K1P 5H9 - Attn.: Tech. Coord. Your input will be considered for inclusion at the time of the next revision.

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WASTE DATA SHEET

NAME OF WASTE: HEAT EXCHANGER CLEANINGS - LIQUIDS

(SYNONYM)

SHEET NO. V-11

DATE November 1986

REV'N NO. 0

SECTION 1 - WASTE INFORMATION

SOURCE: MISCELLANEOUS - Maintenance, Cleaning of Heat Exchangers

GENERAL DESCRIPTION: When high pressure water and/or chemical cleaning agents are used, the liquids require disposal.

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY: 0.8 - 1.2

SOLUBILITY IN WATER: High(aqueous sol'ns)
Low (organics)

APPEARANCE: Depends upon source

ODOUR: No predominant odour

CHEMICAL DATA: Liquids will consist of acids, alkalies or just water.

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT: Those associated with deposits. Organic solvents could be toxic depending upon their composition.

POTENTIAL HAZARDS: All sludges resulting from the cleaning of heat exchangers are "listed" as hazardous under EPA. The liquids may contain some solids and therefore must be considered hazardous. See "Heat Exchanger Cleaning - Solids".

PERSONAL PROTECTION:
- Wear full, impervious, protective apparel such as gloves, footwear, coveralls, etc.
- Eye and facial protection shall be worn.
- Approved respiratory protection appropriate to the identified health hazards must be worn.
- Maintain good personal hygiene and ensure protective equipment is decontaminated after each use.

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:
- Store corrosive liquids in lined tanks or vessels.
- Do not store acid liquids in concrete vessels.
- Other liquids may be stored in steel or lined tanks.

HANDLING PRECAUTIONS:
- In confined spaces specific procedures must be followed.
- Observe fire prevention regulations for volatile organic liquids.
- Prevent release of these waste liquids or the decontamination "washings" into the subsurface waters.

NAME OF WASTE: HEAT EXCHANGER CLEANINGS - LIQUIDS **WASTE DATA SHEET NO.** V-11

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): 3044 **TDGR CLASSIFICATION:** 6.1, 8

TYPE OF CARRIER: Licensed provincial carrier or tank car designed for liquid chemical transport.

WAYBILLS REQUIRED: TDGA Provincial or Federal Manifest

LOADING/UNLOADING PRECAUTIONS: Take same precautions as with strong acids and alkalis. Ensure personnel are adequately protected against skin and eye contact with proper ventilation to avoid inhalation. Ensure carriers are safely loading and verify all flanges are properly sealed.

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND: Aqueous solutions are normally disposed of to the water treatment system. Depending upon the volume involved, neutralization might be advisable in order to protect the bacteria in the biotreater as well as the metallurgy and concrete in the treatment system. Disposal wells are also used satisfactorily.

DISPOSAL GUIDELINE:

Acceptable:
- Waste water treatment after neutralization
- Chemical fixation
- Disposal wells
- Incineration of organics

Not Recommended:
- Release of large quantities of non-neutralized liquid to waste water treatment system.

SECTION 7 - SELECTED REFERENCES

1. American Petroleum Institute "1982 Solid Waste Survey" by Environmental Resources Management Inc., West Chester, Pennsylvania, U.S.A. (zip code 19380).

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WASTE DATA SHEET

NAME OF WASTE:

(SYNONYM)

SHEET NO. ______________

DATE ______________

REV'N NO. ______________

SECTION 1 - WASTE INFORMATION

SOURCE:

GENERAL DESCRIPTION:

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY:

SOLUBILITY IN WATER:

APPEARANCE:

ODOUR:

CHEMICAL DATA:

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

POTENTIAL HAZARDS:

PERSONAL PROTECTION:

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

HANDLING PRECAUTIONS:

NAME OF WASTE: ______________________ **WASTE DATA SHEET NO.** ________

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): **TDGR CLASSIFICATION:**

TYPE OF CARRIER:

WAYBILLS REQUIRED:

LOADING/UNLOADING PRECAUTIONS:

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND:

DISPOSAL GUIDELINE:

Acceptable:

Not Recommended:

SECTION 7 - SELECTED REFERENCES

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WASTE DATA SHEET

NAME OF WASTE:

(SYNONYM)

SHEET NO. ____________________

DATE ____________________

REV'N NO. ____________________

SECTION 1 - WASTE INFORMATION

SOURCE:

GENERAL DESCRIPTION:

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY:

SOLUBILITY IN WATER:

APPEARANCE:

ODOUR:

CHEMICAL DATA:

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

POTENTIAL HAZARDS:

PERSONAL PROTECTION:

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

HANDLING PRECAUTIONS:

NAME OF WASTE: ______________________________ WASTE DATA SHEET NO. __________

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): TDGR CLASSIFICATION:

TYPE OF CARRIER:

WAYBILLS REQUIRED:

LOADING/UNLOADING PRECAUTIONS:

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND:

DISPOSAL GUIDELINE:

Acceptable:

Not Recommended:

SECTION 7 - SELECTED REFERENCES

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WASTE DATA SHEET

NAME OF WASTE:

(SYNONYM)

SHEET NO. ____________

DATE ____________

REV'N NO. ____________

SECTION 1 - WASTE INFORMATION

SOURCE:

GENERAL DESCRIPTION:

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY:

SOLUBILITY IN WATER:

APPEARANCE:

ODOUR:

CHEMICAL DATA:

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

POTENTIAL HAZARDS:

PERSONAL PROTECTION:

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

HANDLING PRECAUTIONS:

NAME OF WASTE: ______________________________ WASTE DATA SHEET NO. ________

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): **TDGR CLASSIFICATION:**

TYPE OF CARRIER:

WAYBILLS REQUIRED:

LOADING/UNLOADING PRECAUTIONS:

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND:

DISPOSAL GUIDELINE:

Acceptable:

Not Recommended:

SECTION 7 - SELECTED REFERENCES

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WASTE DATA SHEET

NAME OF WASTE:

(SYNONYM)

SHEET NO. ____________

DATE ____________

REV'N NO. ____________

SECTION 1 - WASTE INFORMATION

SOURCE:

GENERAL DESCRIPTION:

SECTION 2 - PHYSICAL/CHEMICAL DATA

PHYSICAL DATA:

SPECIFIC GRAVITY:

SOLUBILITY IN WATER:

APPEARANCE:

ODOUR:

CHEMICAL DATA:

SECTION 3 - HAZARD INFORMATION AND PERSONAL PROTECTION

TOXIC COMPONENTS POSSIBLY PRESENT:

POTENTIAL HAZARDS:

PERSONAL PROTECTION:

SECTION 4 - HANDLING AND STORAGE

STORAGE METHODS:

HANDLING PRECAUTIONS:

NAME OF WASTE: ______________________ **WASTE DATA SHEET NO.** ________

(SYNONYM):

SECTION 5 - TRANSPORTATION

TDGR IDENTIFICATION NUMBER (PIN): **TDGR CLASSIFICATION:**

TYPE OF CARRIER:

WAYBILLS REQUIRED:

LOADING/UNLOADING PRECAUTIONS:

SECTION 6 - TREATMENT AND DISPOSAL GUIDELINES

BACKGROUND:

DISPOSAL GUIDELINE:

Acceptable:

Not Recommended:

SECTION 7 - SELECTED REFERENCES

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PART B

THE WASTE MANAGEMENT CHALLENGE

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PART B

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THE WASTE MANAGEMENT CHALLENGE

1.0 INTRODUCTION

This section of the manual is designed to assist the reader in understanding many of the complexities surrounding the waste management issue. It discusses an approach to the development of a waste management plan and explains in general terms the legislative rules that must be met in classifying wastes according to their degree of hazard. Recommended plant policies and procedures are presented along with a brief overview of current treatment and disposal technologies.

As mentioned earlier in the Foreward, the term "plant" is used when referring to both petroleum refineries and heavy oil upgrading facilities. Definitions of "waste" and "hazardous waste" are based on those developed in 1979 by the federal "Task Force on Hazardous Waste Definition", namely,

WASTE: "Any material for which the owner/generator has no further use and which he discards."

HAZARDOUS WASTE: "Wastes which due to their nature and quantity are potentially hazardous to human health and/or the environment and which require special disposal techniques to eliminate or reduce the hazard."[1]

Other definitions and abbreviations used throughout the manual are contained in the Glossary contained in Part C, Appendix 1.

1.1 BACKGROUND

There is general agreement among scientists and regulators that waste disposal is the leading environmental issue to emerge in the last ten years.[2] The hazards of poor waste management practices have only been recognized in recent years, mainly due to the widely publicized cases such as the Love Canal landfill site at Niagara Falls, New York and the spreading of dioxin contaminated oil, as a road dust suppressant, in Times Beach, Missouri.

In Canada, although the situation does not appear to be as critical as in the United States, there is evidence of widespread concern among the public over the apparent inability of government and industry to effectively manage toxic wastes. The recently published "State of the Environment Report for Canada" (May 1986) states, "As populations and urban areas grow, satisfactory landfill sites are becoming difficult to find. Concern is expressed not only about the availability of adequate space and costs involved, but also about the health risks associated with the disposal of hazardous substances and their subsequent seepage or release into the environment." Specifically, concerns centre around the tainting of groundwater and fresh drinking water supplies, destruction of fish and wildlife habitats, and impacts on agricultural food crops and livestock.

To further complicate matters, other aspects that have to be considered when dealing with wastes include:

(1) The large number and increasing volumes of different waste materials being generated by society as a whole.

(2) Sorting through a variety of options for dealing with these wastes, not all of which are economical.

(3) The environmental consequences of many of these treatment and disposal options are as yet, not very well understood.

(4) Public fears and their reluctance to have hazardous waste treatment facilities located in their communities.

It is therefore not surprising to find that many experts believe that waste management is the single most important, controversial and difficult environmental problem of our time.

Turning now to industry we see that, by its very nature, industry cannot function without generating waste by-products. It must therefore, in its daily activities, take the necessary steps to ensure that its wastes, especially those that are hazardous, are minimized and that the remaining residues are processed to render them harmless, or disposed of in a manner that will not have negative effects on the environment.

This manual should assist in attaining this goal by improving the level of understanding among plant operators concerning the nature of their wastes and the practices to be followed in order to protect the environment. It is designed to be used by both line and staff personnel working at plant locations who have the responsibility of managing the large number of waste streams, in a cost effective and environmentally acceptable manner.

Objectives of this manual are to maximize resource conservation and recovery at the plant level and to assist both industry and government in protecting human health and the environment from the improper disposal of potentially harmful wastes.

2.0 WASTE MANAGEMENT

Good waste management planning requires knowledge of the in-plant sources and types of waste, acceptable industrial practices, and a corporate will to carry out an agreed upon program. At first the importance of a comprehensive waste management program is not always obvious. However, experience has shown that lack of planning in this area can be disastrous. Poor waste handling practices can not only damage the environment, but also result in adverse social, legal, political and economical repercussions against the polluting company. The following sections are provided as a guide to assist in the planning function. They focus on:

(1) The fundamental philosophy on which the plan is based,
(2) The mechanism for deciding whether a waste is hazardous or not, and
(3) A framework for developing a site specific waste management plan.

2.1 WASTE MANAGEMENT PHILOSOPHY

In the past ten years there has been an increasing awareness in industry that good waste management is simply good business practice. PACE member companies in dealing with a broad range of petroleum feedstocks, products, by-products and chemical additives, have assumed the principle of "cradle to grave" stewardship. This means the acceptance of responsibility for ensuring that the hazards associated with the handling of these materials do not present an unreasonable risk to public health or the environment, over the entire life cycle of that commodity. This encompasses the manufacture, transport and distribution, use and ultimate disposal of these materials.

Company management has the responsibility and should be held accountable for establishing and maintaining a committed organization, adequate training of employees, providing and enforcing good environmental procedures and performing ongoing audits of waste treatment and disposal activities under their control. Although this responsibility originates at the top with the chief executive officer, it is transmitted to line refinery managers at the local plant level. The chief executive officer should ensure that these line managers have adequate staff specialist support to meet their responsibilities. Each company operating location, be it a refinery or upgrader, must be in a position to handle its industrial and hazardous waste in accordance with company policies and existing environmental legislation.

This position is reflected in a special report on this subject which states, "As with every other business risk, both the potential for a pollution related incident and the potential severity of its consequences can be reduced or eliminated through sensible planning and effective management."[3]

Recently, three factors in the waste management field, i.e. (1) the increased cost of waste disposal, (2) the diminishing insurance availability and coverage, and (3) the high cost of hazardous waste litigation, have led to the conclusion that it makes sound economic sense to pay now for adequate pollution control rather than later, for costly environmental restoration. Even in difficult economic times, effective waste management practices are a must if profits are not to be further eroded. "Both sudden, accidental releases of wastes, and long-term, unknown hazards that surface after many years are halting production lines, shutting down plants, involving top executives in crippling litigation, and battering some companies into bankruptcy."[3]

There is a general consensus among industry and government that the first goal of a waste management program is to reduce the quantity of waste to an absolute minimum. This is accomplished by critically examining each waste stream in terms of the "Four R's", i.e.:

- Reduction
- Reuse
- Recycling
- Recovery [4]

Only after these four approaches to waste management have been exhausted should the residual materials be considered for more sophisticated (and costly) means of treatment and disposal. The methods adopted will be largely dependent on the nature and characteristics of the remaining final waste material.

Examples of the options for treatment and disposal, depending on the waste characteristics, include the following:

- Biological land treatment of select organic wastes.
- Secure landfill.
- Sanitary landfill for stabilized and inert materials.
- High temperature, high residence time incineration.
- Chemical solidification or fixing of fluid residues into inert solids suitable for landfill.
- Chemical or biological treatments for detoxification prior to disposal.

2.2 WASTE SOURCES

Figures 1 and 2 are simplified schematic flow diagrams showing the major process unit blocks contained within a refinery or heavy oil upgrader. In addition to the process units, each plant requires storage, loading and shipping facilities, intake water and waste water treatment systems, and utility facilities. All of these are potential sources of wastes.

Each plant should develop its own inventory of waste streams. In this manual, some 55 separate waste streams have been identified and grouped together according to functional source.

FIGURE 1 - SIMPLIFIED FLOW CHART OF A COMPLEX PETROLEUM REFINERY

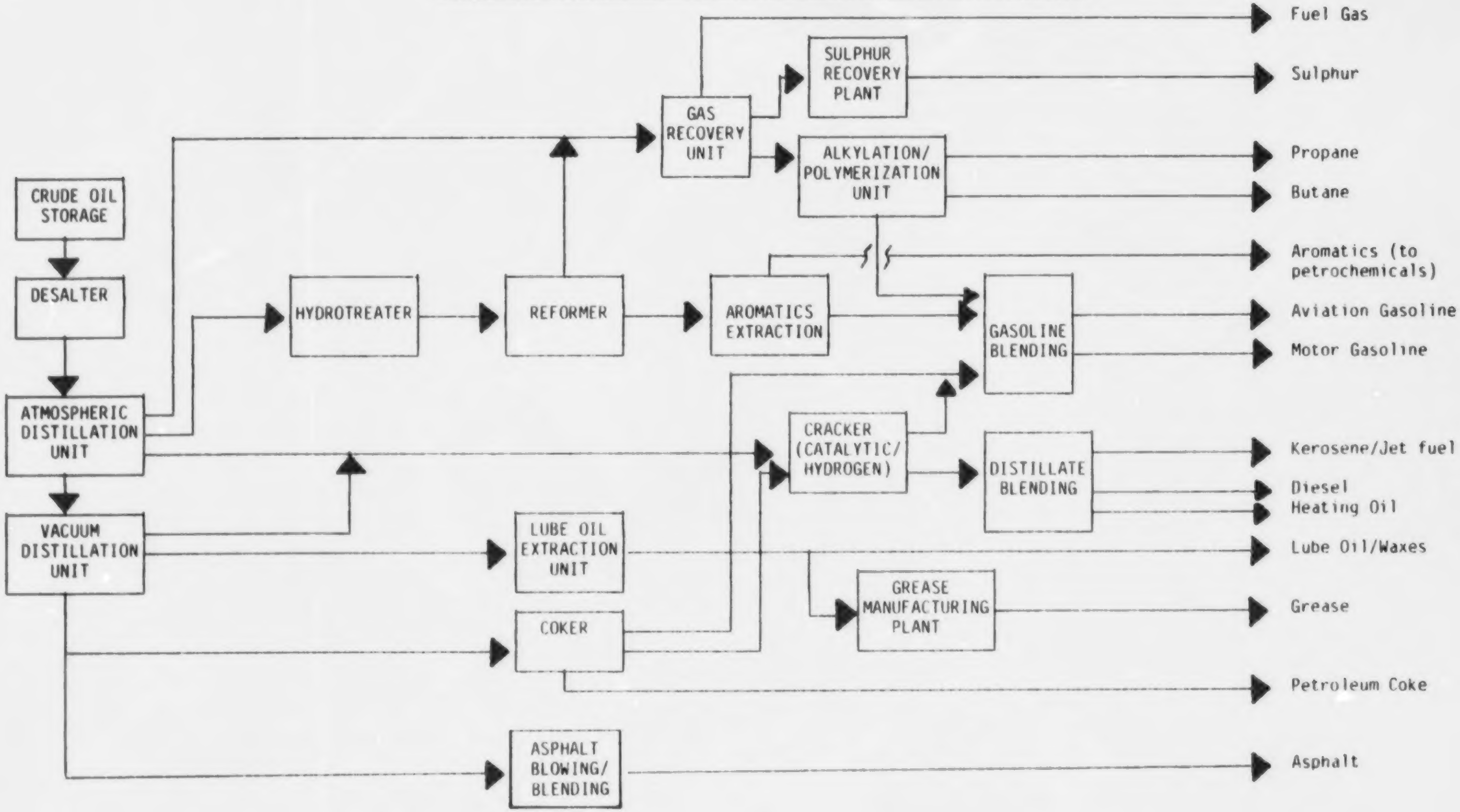


FIGURE 2 - SIMPLIFIED FLOW CHART OF A HEAVY OIL UPGRADER

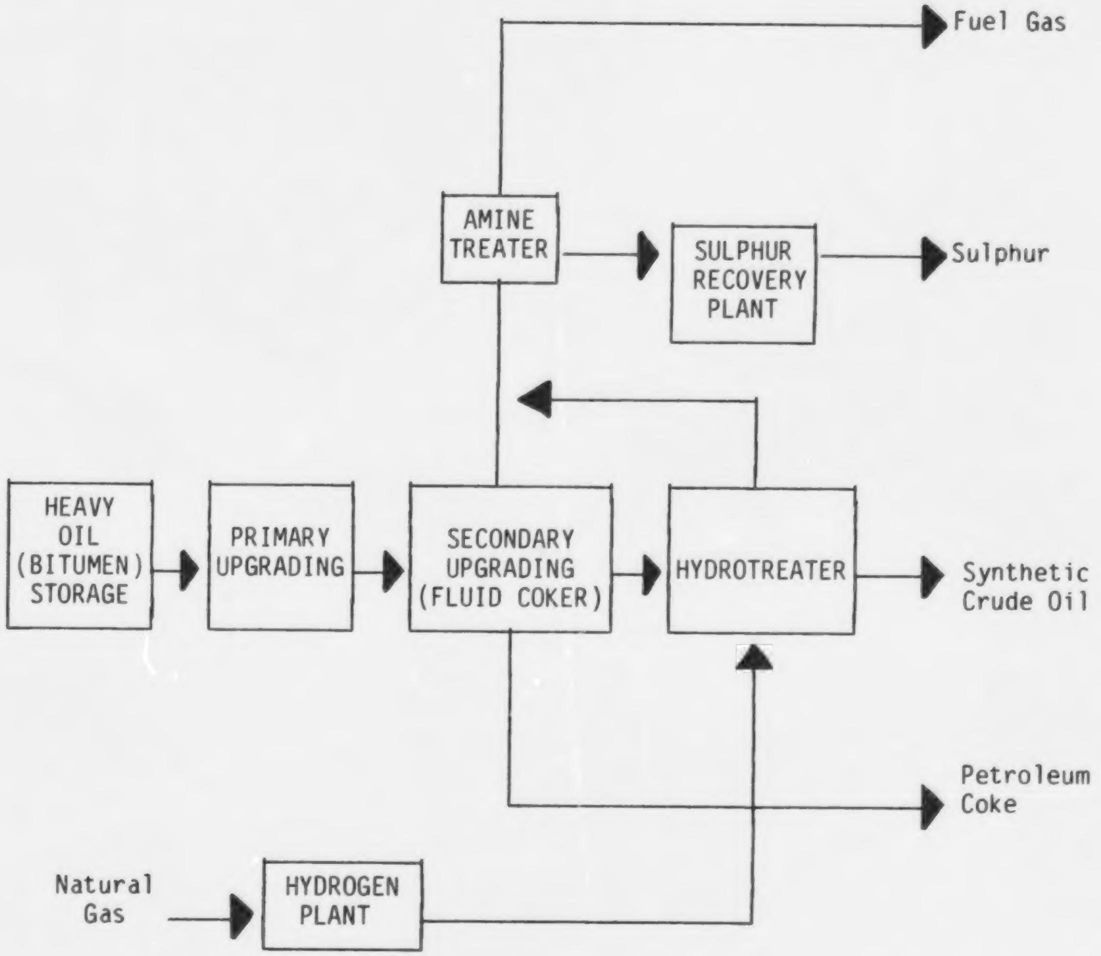
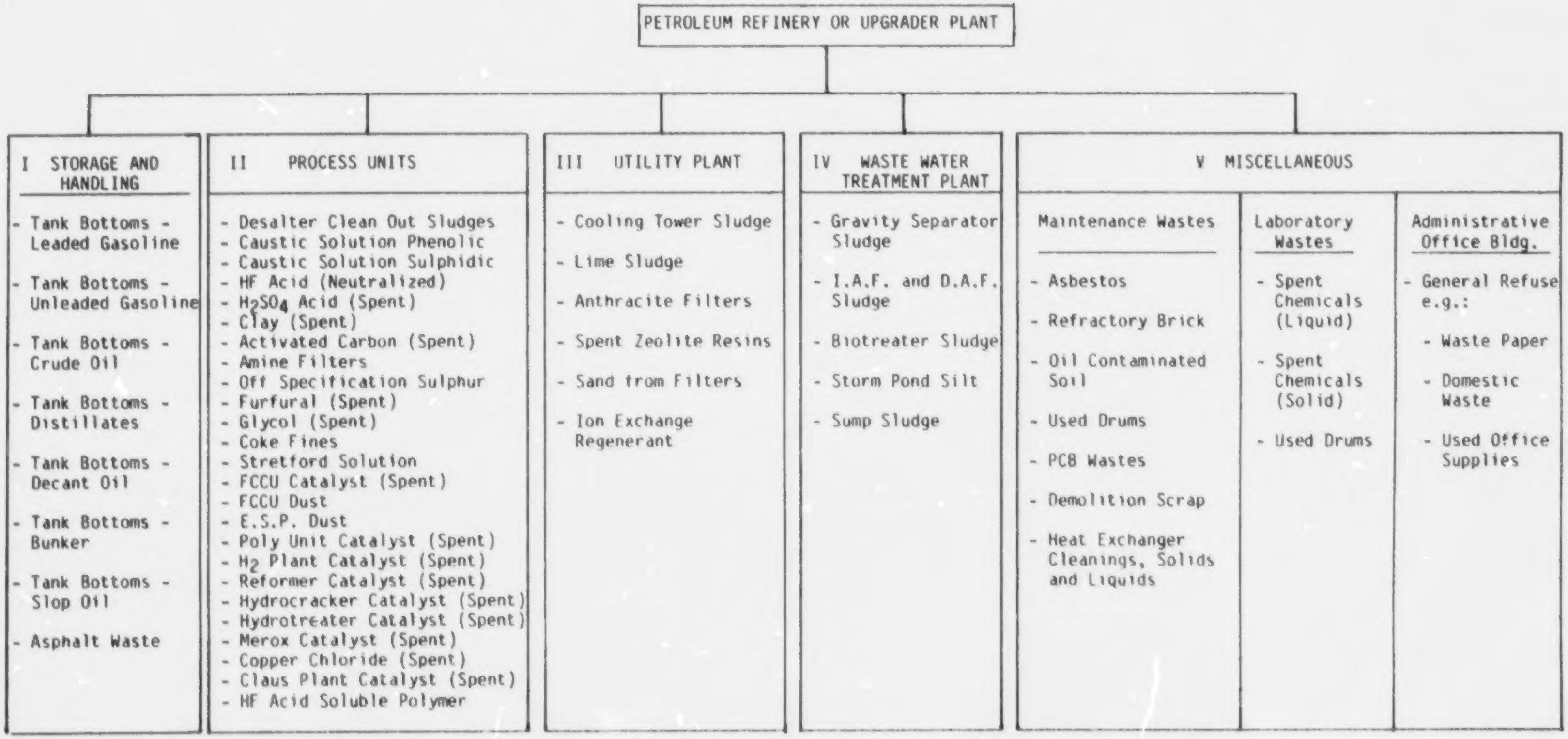


FIGURE 3 - EXAMPLE OF SOURCE OF PLANT WASTE



PETROLEUM REFINERY OR UPGRADER PLANT

I STORAGE AND HANDLING
- Tank Bottoms - Leaded Gasoline
- Tank Bottoms - Unleaded Gasoline
- Tank Bottoms - Crude Oil
- Tank Bottoms - Distillates
- Tank Bottoms - Decant Oil
- Tank Bottoms - Bunker
- Tank Bottoms - Slop Oil
- Asphalt Waste

II PROCESS UNITS
- Desalter Clean Out Sludges
- Caustic Solution Phenolic
- Caustic Solution Sulphidic
- HF Acid (Neutralized)
- H_2SO_4 Acid (Spent)
- Clay (Spent)
- Activated Carbon (Spent)
- Amine Filters
- Off Specification Sulphur
- Furfural (Spent)
- Glycol (Spent)
- Coke Fines
- Stretford Solution
- FCCU Catalyst (Spent)
- FCCU Dust
- E.S.P. Dust
- Poly Unit Catalyst (Spent)
- H_2 Plant Catalyst (Spent)
- Reformer Catalyst (Spent)
- Hydrocracker Catalyst (Spent)
- Hydrotreater Catalyst (Spent)
- Merox Catalyst (Spent)
- Copper Chloride (Spent)
- Claus Plant Catalyst (Spent)
- HF Acid Soluble Polymer

III UTILITY PLANT
- Cooling Tower Sludge
- Lime Sludge
- Anthracite Filters
- Spent Zeolite Resins
- Sand from Filters
- Ion Exchange Regenerant

IV WASTE WATER TREATMENT PLANT
- Gravity Separator Sludge
- I.A.F. and D.A.F. Sludge
- Biotreater Sludge
- Storm Pond Silt
- Sump Sludge

V MISCELLANEOUS

Maintenance Wastes
- Asbestos
- Refractory Brick
- Oil Contaminated Soil
- Used Drums
- PCB Wastes
- Demolition Scrap
- Heat Exchanger Cleanings, Solids and Liquids

Laboratory Wastes
- Spent Chemicals (Liquid)
- Spent Chemicals (Solid)
- Used Drums

Administrative Office Bldg.
- General Refuse e.g.:
  - Waste Paper
  - Domestic Waste
  - Used Office Supplies

Figure 3 (same as Figure 1 in Part A) identifies typical waste streams by source category.

There are basically five major source groupings of wastes in a petroleum plant. These are:

- I. Storage and Product Handling Operations
- II. Process Units
- III. Utility Plant - Steam Generation - Cooling Water
- IV. Wastewater Treatment Facilities
- V. Miscellaneous - including:
  - maintenance
  - laboratory
  - administrative office building

2.3 WASTE CLASSIFICATION

Once the inventory list of wastes has been compiled, it is important to describe these streams in terms of both volume and physical/chemical characteristics. Both the volume and the nature of the waste determines its classification as either hazardous or non-hazardous. These are either defined by, (1) a prescribed list contained in Provincial Waste Regulations or the Transportation of Dangerous Goods (TDG) Regulations, or (2) as criteria defined in the regulations against which each individual stream must be judged to establish whether or not it is hazardous.

Although TDGA defines 9 classes of dangerous goods, criteria under which hazardous wastes have been classified are generally limited to the following:

1. Explosivity
2. Ignitability/Flammability
3. Corrosivity
4. Reactivity
5. Toxicity
6. Radioactivity

In the case of solid or semi-solid wastes, a leachate test to determine the toxicity of the water extract of the waste is also a requirement (see Part B, Appendix 3). Such a test is useful in assessing the potential for contaminating soil and groundwater with leachable toxic materials like certain heavy metals.

Table 1 lists examples of waste materials from petroleum plants that are designated as hazardous under the provincial and federal regulations. In addition, many provincial environmental agencies have either developed or are in various stages of developing their own lists and hazard criteria. For this reason it is strongly suggested that the user contact his local agency in order to establish the latest regulatory requirements for classification, labelling, transport and disposal. This

TABLE 1

EXAMPLES OF PROVINCIALLY AND FEDERALLY LISTED HAZARDOUS WASTES FROM PETROLEUM PLANTS (ONTARIO REGULATION 309 AND FEDERAL TDG REGULATIONS)

		FEDERAL TDGR			
WASTE	ONTARIO WASTE NUMBER	PRODUCT IDENTIFICATION NUMBER (PIN)	WASTE TYPE NUMBER	CLASSIFICATION	PACKING GROUP
Dissolved Air Flotation (DAF) Float	NA9374	9374	74	3.1	II
Slop Oil Emulsion Solids	NA9375	9375	75	6.1	II
Heat Exchanger Bundle Cleaning Sludge	NA9376	9376	76	6.1 8	II
API Separator Sludge	NA9377	9377	77	3.1 6.1	II
Gasoline Tank Bottoms (Leaded)	NA9378	9378	78	6.1	II
Coker - ammonia still lime sludge	---	9379	79	9.3	III
Coker - decanter tank tar sludge	---	9397	97	6.1	II

section is simply designed to acquaint the reader with the general approaches taken in Canada when classifying waste for regulatory purposes.

Figure 4 is a schematic logic diagram illustrating the process for such classification. First, it should be determined whether the waste is on the federal or the pertinent provincial list of hazardous materials. Next, using criteria for explosivity, ignitability, corrosivity, reactivity and toxicity, a determination is made as to whether the waste falls within the hazardous definition. In addition, there is generally a small volume exemption, which if below this limit, the waste is deemed to be non-hazardous, even though it meets the other criteria for a hazardous waste.

Most provincial agencies encourage discussion of waste disposal plans and generally grant permits or certificates of approval on a case-by-case basis. Such permits are issued only after a thorough engineering analysis of the proposed plan has been carried out. It is advisable therefore that the plant develop an adequate data base and an understanding of the nature of its waste streams prior to submitting its application for the necessary approvals.

2.4 WASTE MANAGEMENT PLAN

The overall objective of the waste management plan is to:

1. Practice resource conservation and recovery.
2. Reduce plant waste disposal cost.
3. Comply with regulatory requirements.
4. Protect the environmental integrity of soil, surface and groundwater in the immediate vicinity of the plant site.
5. Avoid transferring a waste disposal problem into an air pollution problem, e.g. through improper application of incineration.
6. Prevent migration of harmful waste components in off-site landfills or other third party treatment facilities that are directly attributable to processing of plant wastes.
7. Avoid future costly clean-up and decontamination during plant decommissioning stage.

A properly integrated waste management plan also will require a systematic approach in dealing with questions of on-site versus off-site treatment and ultimate disposal options.

FIGURE 4 - WASTE CLASSIFICATION

DECISION TREE TO BE FOLLOWED TO DETERMINE IF WASTE IS HAZARDOUS OR NOT

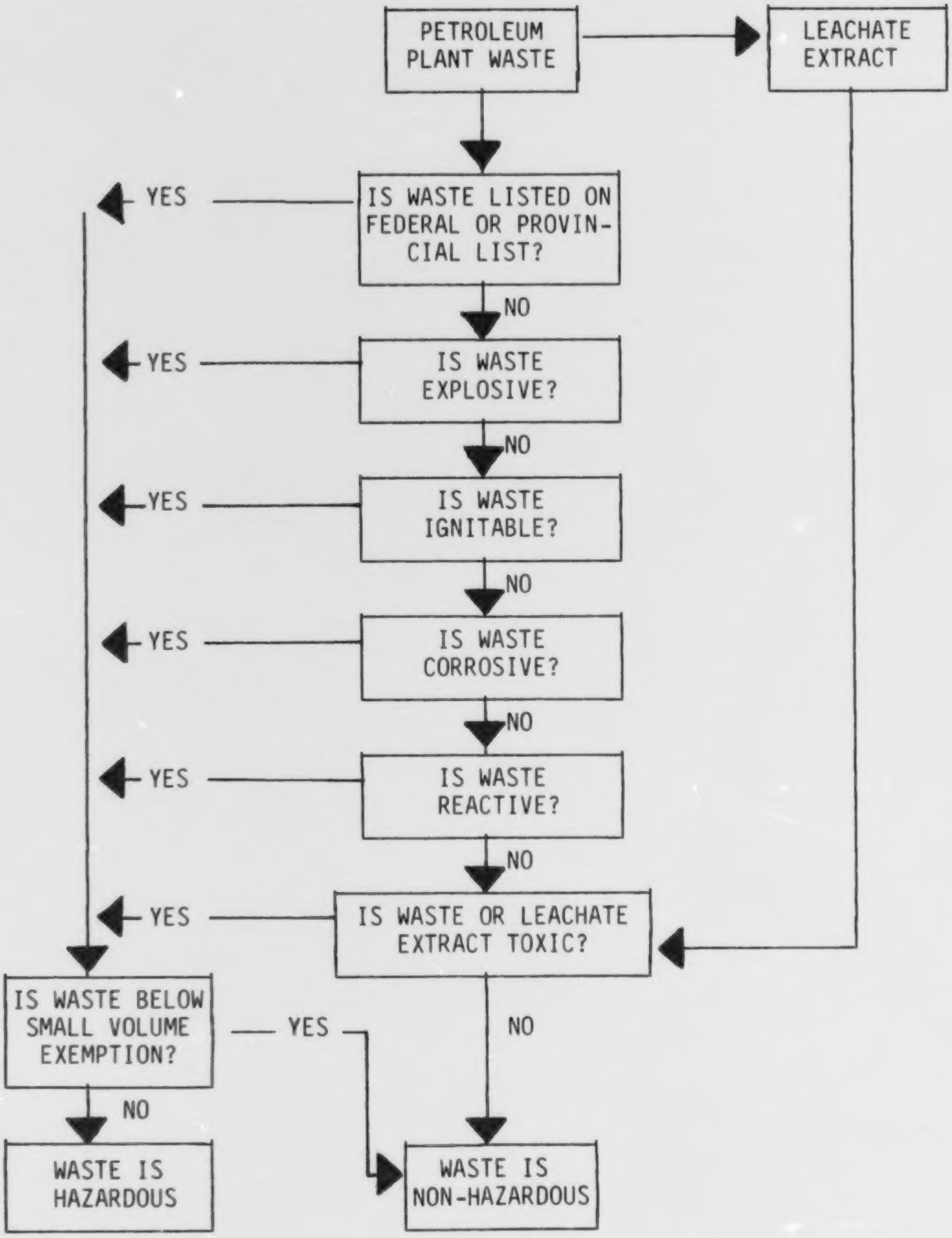


FIGURE 5 - WASTE MANAGEMENT PLAN

SCHEMATIC FLOW DIAGRAM

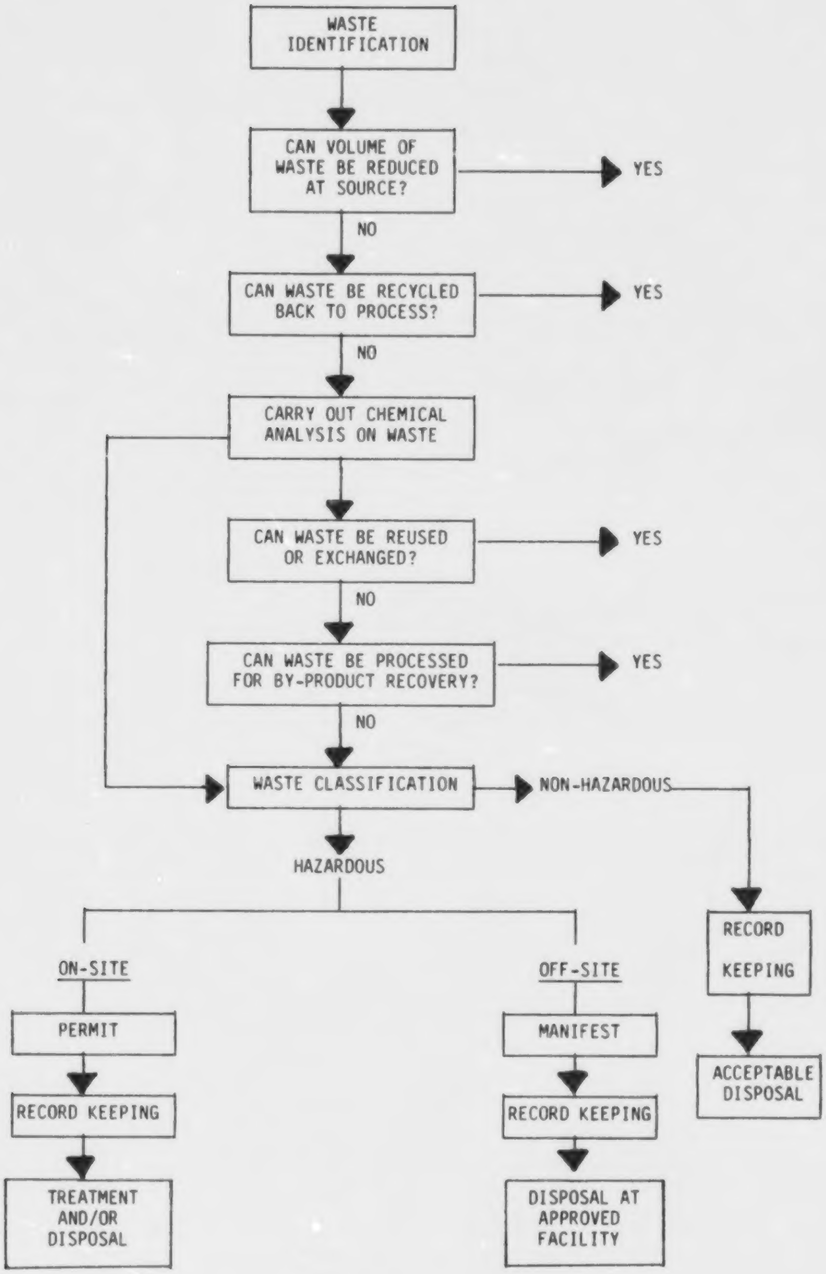

WASTE IDENTIFICATION
CAN VOLUME OF WASTE BE REDUCED AT SOURCE?
YES
NO
CAN WASTE BE RECYCLED BACK TO PROCESS?
YES
NO
CARRY OUT CHEMICAL ANALYSIS ON WASTE
CAN WASTE BE REUSED OR EXCHANGED?
YES
NO
CAN WASTE BE PROCESSED FOR BY-PRODUCT RECOVERY?
YES
NO
WASTE CLASSIFICATION
NON-HAZARDOUS
HAZARDOUS
ON-SITE
OFF-SITE
RECORD KEEPING
PERMIT
MANIFEST
ACCEPTABLE DISPOSAL
RECORD KEEPING
RECORD KEEPING
TREATMENT AND/OR DISPOSAL
DISPOSAL AT APPROVED FACILITY

Figure 5 provides a framework for such a plan. For each waste generated, an analysis is carried out based on a hierarchy of preferred options. Generally speaking, the preferred route after reduction, recycling, and waste exchange options have been exhausted is to examine the feasibility and economics of on-site treatment and disposal. In such cases storage facilities usually must be provided for the waste streams.

Waste disposal areas such as land treatment (landfarming) or secure landfill sites must be adequately engineered, maintained and monitored. There should be a contingency plan in the event of a system failure. Application for permits from the provincial agencies will, in many cases, involve public meetings so that good communication links should be established with the stakeholders in the community.

If the investigation points to off-site treatment/disposal then proper shipping, manifesting, placarding, and labelling will have to be provided. In addition, it is recommended that a review of the contractor's treatment and disposal system be undertaken to ensure that adequate treatment and proper final disposal is carried out.

Record keeping of each and every transaction, both for on-site and off-site disposal, is an important part of the plan and will be discussed in more detail in Section 4, "Recommended In-plant Policies and Procedures."

In summary, it is recommended that each refinery undertake a site specific waste management program based on the guidelines provided in this Manual. Such a program should be developed in concert with company environmental specialists or experienced outside engineering consultants in the field.

REFERENCES

1. Federal Task Force on Hazardous Waste Definition - October 1979.

2. State of the Environment - 1982
Report of the Conservation Foundation, Washington, D.C.

3. The Waste Management Challenge
Environmental Technology Inc., 1983.

4. Blueprint for Waste Management
Ontario Ministry of the Environment, June 1983.

2.5 EXAMPLES OF THE 4 "R's" APPLIED TO PETROLEUM PLANTS

As mentioned earlier, a comprehensive waste management program is built on the foundation of the 4 "R"'s, i.e. Reduction, Recovery, Re-use and Recycling. Strictly speaking, "REDUCTION", the first "R" encompasses all four since the appliction of "RECOVERY", "RE-USE" and "RECYCLING" results in a reduction of waste to be disposed of. These terms are defined in the Glossary contained in Part C, Appendix 1.

The concepts of reducing and transforming a waste into a less hazardous form are so important in the overall waste management scheme that this section is devoted to highlighting common examples used in petroleum plants.

The significance of waste reduction techniques becomes apparent when the results of a survey conducted for the American Petroleum Institute in 1982 are reviewed. This survey[1] points out that only 35% of the raw wastes generated required disposal. The remaining 65% was reduced through settling, decantation, recycling or reuse by another facility. Such efforts are highly cost effective and should be considered whenever a waste is generated and must be disposed of.

A number of common waste reduction techniques applicable to petroleum plants are as follows:

2.5.1 REDUCTION

1. Crude Tank Sludges

The volume of deposited sludge in the bottom of crude oil tanks may be reduced in a number of ways. These include:

- Install variable angle tank mixers.
- Use hot oil cleaning and mixers to slurry the deposits before tank cleaning.
- Use double covered floating roofs with tight seals to reduce oxidation which forms gums and resins that contribute to the formation of tank bottom sludges.
- Incorporate designs that facilitate oil sludge recovery and establish clean-out procedures.

2. Spent Lime From Water Treatment

- Reduce steam consumption thereby reducing feed water volume required, e.g. reboiler for steam stripping.

- Return valuable steam condensates thus reducing feed water requiring treatment.

- Use heat transfer oils in place of steam

- Use a pond or centrifuge to concentrate solids in the lime sludge, thereby reducing sludge volume.

3. Cooling Tower Sludges

- In selected situations, consider air cooling as an alternative to water cooled exchangers.

- Eliminate leaks from process side of exchangers and overuse of treatment chemicals.

- Use a soft, non-scaling water if practicable, such as purified storm water where available.

- Optimize the number of concentration cycles in the cooling tower thereby reducing chemical costs and the quantity of solids which will precipitate out in the system.

4. Filter Clays

- Regenerate or recycle the clay.

- A fixed bed produces less spent clay than a fluid bed unit.

5. Spent Caustic

- Consider advantages of using stronger caustic which will reduce volume of spent caustic and make costs of shipping phenolic caustic outside the plant more attractive.

2.5.2 RE-USE/RECLAMATION

1. Spent Caustic

- Pulp mills and cement plants can sometimes accept sulphidic caustic waste.

- Cresylic acids can be reclaimed from phenolic caustics.

2. FCCU Catalyst

- Removal of toxic metals such as nickel and vanadium from feedstock can reduce need for catalyst withdrawal.

3. Reformer/Hydrotreater/Hydrogen Plant/ Hydrocracker Catalyst

   - Platinum and other metals may be recovered by catalyst supplier.

4. Poly Unit Catalyst

   - Consider use of spent phosphoric acid catalyst on landfarm as a phosphorous nutrient.

2.5.3 RECYCLE

1. Air Flotation

   - Recycle float to inlet of API Separator.

2. Slop Tank Sludges

   - Use a mixer on bottom sludges and recycle on a controlled basis to crude unit or preferably to FCCU fractionator. Care must be taken to ensure that lead is not introduced into the crude unit since it can poison Reformer Catalyst.

3. Bunker Tank Sludges

   - May be recycled to crude stream or FCCU feed after mixing with hot oil to reduce viscosity.

   - Consider recycling in a Coker Unit if available.

4. Furfural Sludges

   - Consider recycling to bunker or asphalt.

5. Hydrofluoric Acid Soluble Polymer

   - The polymer is normally separated from the HF acid and burned. However, separation can run the risk of acid contamination. A better approach is to recycle this polymer to the FCCU.

6. Asphalt

   - Melting the asphalt in a steam jacketed box and subsequent recycling it back into the system.

   - Light asphalt can be mixed into a bunker tank provided it does not contain volatile cutback solvent materials.

REFERENCES

1. American Petroleum Institute "1982 Refinery Solid Wastes Survey", Environmental Resources Management Inc., West Chester, Pennsylvania, U.S.A. 19380.

2. Canadian Waste Materials Exchange, issued six times annually by Ontario Research Foundation, Sheridan Park Research Community, Mississauga, Ontario L5K 1B3.

3.0 SURVEY OF INDUSTRY WASTE MANAGEMENT PRACTICES

This section summarizes the results of a questionnaire sent by PACE to 29 refineries (both PACE and non-PACE members) and 2 upgrading plants prior to development of this manual (1985). Replies were received from 26 refineries and 1 upgrading plant. (See Part C, Appendix 6 for complete listing).

The survey was designed to be more qualitative than quantitative in nature and aimed at assessing the number and type of different waste streams that petroleum plants must deal with. It was divided into three separate sections, the first dealing with process information, the second with identifying the number and approximate volumes of waste materials being generated, and the third with the methods used for treatment and disposal.

Replies to the first section of the questionnaire showed only slight changes to the size and number of process units in operation in comparison with an earlier PACE report (PACE Report No. 85-1) and the industry census published in the June 10, 1985 issue of Oilweek.

The second section identified a total of 55 different wastes. In addition, several refineries added one of a kind wastes peculiar to their own plant operations. These were not added to the list unless they differed significantly or required a disposal technique very different from those commonly identified. The summary of this section of the survey (Table 2) shows the number of plants producing each particular kind of waste.

The third section of the survey summarizes the usual methods by which these wastes are removed, handled, stored, treated, disposed of and monitored. Some difficulty was encountered in providing a summary of this section due to the following factors:

1. More than one method of handling, storage, treatment and disposal was often stated. If more than one method was used, each was given equal weight in the summary.

2. Specific details were not provided so inferences had to be used in some cases.

3. Various terms were used to explain disposal methods. Terms such as composting were used in place of land treatment.

The results of the third section of the survey are summarized in Table 3. The term "waste" has been defined as any solid or liquid for which the generator has no further use and therefore must be discarded. The definition includes wastes which have a monetary value when reclaimed, i.e. where a component of the waste is recovered for its commercial value, outside of the plant. Reformer catalysts and spent caustic are good examples. Materials recycled within the plant are also included to provide a more comprehensive understanding of the extent to which all wastes are being reused or recycled.

A survey conducted by PACE in 1980 reported the following breakdown of disposal methods on a weight basis:

Landfill	35.7
Landtreatment (landfarming)	17.8
Reuse/Recovery	29.7
*Deepwell	1.4
Incineration	6.9
Other or unspecified	8.5
	100.0%

* Excludes process liquid effluent

This same survey showed that the total weight of wastes generated was approximately 200 000 tonnes, 40.4% of which came from on-site operations and 59.6% from off-site. In the 1985 survey used for this report, the wastes were not quantified but simply placed in a small (0-1 tonne/year), medium (1-100 tonnes/year) and large (100 plus tonnes/year) category.

Recovery, landfarming and landfilling are the principle means used to reduce the volume or dispose of wastes generated. Most refineries today have land treatment (landfarm) areas for the disposal of organic wastes of various kinds. When properly designed and operated efficiently, land treatment has proven itself as an acceptable method of dealing with these wastes. There is always the possibility that some of the oily wastes now being landfarmed could be recovered should the economics for oil recovery prove favourable.

Deepwell disposal and incineration are used for only a small number of wastes. Deepwell disposal has been practiced for several years in Alberta and Saskatchewan, with no known adverse effects to the underground formation. This success is due largely to the presence of underground formations at 600 to 2000 metres which meet all of the requirements for a successful deepwell disposal facility.

The last section of the survey indicates that the techniques for handling, storage and treatment are fairly well defined and understood. There are, however, some unique methods used which could be of interest to refineries with a particular problem. These have been outlined. Further details will be found in Section 6 "Treatment Technologies and Disposal Options".

Recycling waste streams inside the plant and reuse or reclamation outside of the plant are methods being applied to a very significant degree. No doubt the future will see further growth in this area as the cost of disposal increases.

REFERENCES

1. PACE Report No. 80-4 "Canadian Petroleum Refining Industry Waste Survey."

TABLE 2

SURVEY OF CURRENT DISPOSAL PRACTICES IN CANADIAN REFINERIES

(1985)

S = <1 Tonnes/Year
M = 1-100 Tonnes/Year
L = >100 Tonnes/Year

						DISPOSAL PRACTICES - % OF REPLIES											
WASTE SOURCE (PLANT AREA)	NAME	NO. OF PLANTS WITH WASTE	QUANTITY			LANDFILL		LANDFARM		INCINERATION		REUSED RECYCLED		DISPOSAL WELL		WASTE WATER TREAT-MENT	OTHER
			S	M	L	ON-SITE	OFF-SITE	ON-SITE	OFF-SITE	ON-SITE	OFF-SITE	ON-SITE	OFF-SITE	ON-SITE	OFF-SITE		
I STORAGE AND HANDLING	TANK BOTTOMS LEADED GASOLINE	18	X	X		61	17 (Weathered)	11	-	-	-	-	-	-	-	-	11 (Tricil Stablex)
	TANK BOTTOMS UNLEADED GASOLINE	19	X	X		32	15	38	-	-	5	-	-	-	-	-	10 (Tricil Stablex)
	TANK BOTTOMS CRUDE OIL	20	X	X		10	25	50	-	-	5	5	5	-	-	-	-
	TANK BOTTOMS DISTILLATES	20	X	X		10	20	60	-	-	-	5	-	-	-	5	
	TANK BOTTOMS DECANT OIL	8	X	X		-	43	57	-	-	-	-	-	-	-	-	
	TANK BOTTOMS BUNKER OIL	12	X	X	X	7	27	45	7	-	7	7	-	-	-	-	
	SLOP TANK SLUDGES	4	X	X		-	25	50	25	-	-	-	-	-	-	-	
	ASPHALT WASTES	15	X	X		33	28	-	-	-	6	33	-	-	-	-	

TABLE 2 (cont'd)

SURVEY OF CURRENT DISPOSAL PRACTICES IN CANADIAN REFINERIES

(1985)

S = <1 Tonne/Year
M = 1-100 Tonnes/Year
L = >100 Tonnes/Year

WASTE SOURCE (PLANT AREA)	NAME	NO. OF PLANTS WITH WASTE	QUANTITY			DISPOSAL PRACTICES - % OF REPLIES											
						LANDFILL		LANDFARM		INCINERATION		REUSED RECYCLED		DISPOSAL WELL		WASTE WATER TREATMENT	OTHER
			S	M	L	ON-SITE	OFF-SITE	ON-SITE	OFF-SITE	ON-SITE	OFF-SITE	ON-SITE	OFF-SITE	ON-SITE	OFF-SITE		
II PROCESS UNITS	DESALTER SLUDGES	16	X	X		6	28	37	6	-	6	11	-	-	-	-	6 (Tricil)
	PHENOLIC CAUSTIC	18		X	X	-	-	-	-	-	6	-	43	12	6	33	
	SULPHIDIC CAUSTIC	16		X	X	-	-	-	-	-	-	11	40	16	-	33	
	HF ACID (NEUTRALIZED)	7	X			-	43	-	-	-	-	-	-	14	-	43	
	SULPHURIC ACID (SPENT)	4		X	X	-	-	-	-	-	-	-	75	-	-	-	25 (Stablex)
	CLAY (SPENT)	13	X	X		16	37	31	-	-	8	-	-	-	-	-	8 (Stablex)
	CARBON (SPENT)	13	X	X		16	52	8	-	-	-	-	8	-	-	-	16 (Tricil & Stablex)
	AMINE FILTERS	11	X	X		9	82	9	-	-	-	-	-	-	-	-	
	OFF SPEC. SULPHUR	7	X	X	X	44	14	-	-	-	14	14	14	-	-	-	
	FURFURAL (SPENT)	1				-	-	-	-	-	100	-	-	-	-	-	
	GLYCOL (SPENT)	1						-	-	-	100	-	-	-	-	-	
	COKE FINES	8		X	X	38	38	-	-	-	-	-	12	-	-	-	12 (Stablex)
	STRETFORD SOLUTION	1		X		-	-	-	-	-	-	-	-	-	-	100	
	E.S.P. DUST	1		X		-	-	-	-	-	-	100	-	-	-	-	

S = < 1 Tonne/Year
M = 1-100 Tonnes/Year
L = > 100 Tonnes/Year

TABLE 2 (cont'd)

SURVEY OF CURRENT DISPOSAL PRACTICES IN CANADIAN REFINERIES (1985)

						DISPOSAL PRACTICES - % OF REPLIES											
WASTE SOURCE (PLANT AREA)	NAME	NO. OF PLANTS WITH WASTE	QUANTITY			LANDFILL		LANDFARM		INCINERATION		REUSED RECYCLED		DISPOSAL WELL		WASTE WATER TREAT-MENT	OTHER
			S	M	L	ON-SITE	OFF-SITE	ON-SITE	OFF-SITE	ON-SITE	OFF-SITE	ON-SITE	OFF-SITE	ON-SITE	OFF-SITE		
II PROCESS UNITS (cont'd)	FCCU DUST	9	X	X	X	11	89	-	-	-	-	-	-	-	-	-	
	FCCU CATALYST (SPENT)	17		X	X	6	41	12	-	-	-	-	41	-	-	-	
	POLY UNIT CAT. (SPENT)	7		X	X	14	28	30	-	-	-	14	-	-	-	-	14 (Stablex)
	HYDROGEN PLANT CATALYST (SPENT)	7		X	X	13	13	-	-	-	-	-	61	-	-	-	13 (Tricil)
	REFORMER CAT. (SPENT)	18	X	X		-	-	-	-	-	-	-	100	-	-	-	
	HYDROCRACKER CATALYST (SPENT)	5		X	X	-	40	-	-	-	-	-	40	-	-	-	20 (Tricil)
	HYDROTREATER CATALYST (SPENT)	17	X	X	X	12	29	-	-	-	-	-	53	-	-	-	6 (Stablex)
	MEROX CAT. (SPENT)	8	X			-	-	-	-	-	-	-	-	25	-	25	50 (In Spent Caustic)
	COPPER CHLORIDE CATALYST (SPENT)	1			X	-	100	-	-	-	-	-	-	-	-	-	
	CLAUS PLANT CATALYST (SPENT)	4	X	X		75	25	-	-	-	-	-	-	-	-	-	
	HF ACID SOLUBLE POLYMER	1		X		-	16	-	-	-	16	52	-	-	-	16	

S = < 1 Tonnes/Year
M = 1-100 Tonnes/Year
L = > 100 Tonnes/Year

TABLE 2 (cont'd)

SURVEY OF CURRENT DISPOSAL PRACTICES IN CANADIAN REFINERIES

(1985)

WASTE SOURCE (PLANT AREA)	NAME	NO. OF PLANTS WITH WASTE	QUANTITY			DISPOSAL PRACTICES - % OF REPLIES											
						LANDFILL		LANDFARM		INCINERATION		REUSED RECYCLED		DISPOSAL WELL		WASTE WATER TREAT-MENT	OTHER
			S	M	L	ON-SITE	OFF-SITE	ON-SITE	OFF-SITE	ON-SITE	OFF-SITE	ON-SITE	OFF-SITE	ON-SITE	OFF-SITE		
III UTILITY PLANT	COOLING TOWER SLUDGES	16	X	X		25	44	25	6	-	-	-	-	-	-	-	-
	LIME SLUDGE	13		X	X	40	32	14	7	-	-	-	7	-	-	-	-
	ANTHRACITE FILTERS	14	X	X		28	58	14	-	-	-	-	-	-	-	-	-
	SPENT ZEOLITE RESINS	18	X	X		16	62	16	-	-	-	-	6	-	-	-	-
	SAND FROM FILTERS	8		X		22	33	45	-	-	-	-	-	-	-	-	-
	ION EXCHANGE REGENERANT	3		X	X	-	-	-	-	-	-	-	-	-	-	100	

TABLE 2 (cont'd)

SURVEY OF CURRENT DISPOSAL PRACTICES IN CANADIAN REFINERIES

(1985)

S = <1 Tonnes/Year
M = 1-100 Tonnes/Year
L = >100 Tonnes/Year

WASTE SOURCE (PLANT AREA)	NAME	NO. OF PLANTS WITH WASTE	QUANTITY			DISPOSAL PRACTICES - % OF REPLIES											
						LANDFILL		LANDFARM		INCINERATION		REUSED RECYCLED		DISPOSAL WELL		WASTE WATER TREAT-MENT	OTHER
			S	M	L	ON-SITE	OFF-SITE	ON-SITE	OFF-SITE	ON-SITE	OFF-SITE	ON-SITE	OFF-SITE	ON-SITE	OFF-SITE		
IV WASTE WATER TREAT-MENT PLANT	GRAVITY SEPARATOR SLUDGE	25	X	X	X	12	12	56	8	-	4	4	-	-	-	-	4 Aerobic Digester
	I.A.F. AND D.A.F. SLUDGE	11	X	X	X	8	-	49	8	-	8	-	-	-	-	27	-
	BIOTREATER SLUDGE	18		X	X	12	6	70	6	-	-	6	-	-	-	-	-
	STORM POND SILT	15	X	X	X	7	33	60	-	-	-	-	-	-	-	-	-
	SUMP SLUDGES	17	X	X		15	20	50	-	-	5	5	-	-	-	-	5 (Tricil)

S = < 1 Tonnes/Year
M = 1-100 Tonnes/Year
L = > 100 Tonnes/Year

TABLE 2 (cont'd)

SURVEY OF CURRENT DISPOSAL PRACTICES IN CANADIAN REFINERIES

(1985)

WASTE SOURCE (PLANT AREA)	NAME	NO. OF PLANTS WITH WASTE	QUANTITY			DISPOSAL PRACTICES - % OF REPLIES											
						LANDFILL		LANDFARM		INCINERATION		REUSED RECYCLED		DISPOSAL WELL		WASTE WATER TREAT-MENT	OTHER
			S	M	L	ON-SITE	OFF-SITE	ON-SITE	OFF-SITE	ON-SITE	OFF-SITE	ON-SITE	OFF-SITE	ON-SITE	OFF-SITE		
V MISCEL-LANEOUS	ASBESTOS	19	X	X	X	10	90	-	-	-	-	-	-	-	-	-	
	REFRACTORY BRICK	14	X	X	X	43	57	-	-	-	-	-	-	-	-	-	
	GENERAL REFUSE	19		X	X	21	79	-	-	-	-	-	-	-	-	-	
	OIL CONTAMINATED SOIL	23	X	X	X	12	36	48	-	-	-	4	-	-	-	-	
	USED DRUMS	23	X	X		16	8	-	-	-	-	-	76	-	-	-	
	LABORATORY - LIQUIDS	16	X	X		-	-	-	-	-	6	29	-	6	-	59	
	LABORATORY - SOLIDS	16	X	X		38	62	-	-	-	-	-	-	-	-	-	
	PCB WASTES	13	X	X		72%	Stored	On-Site		14%	Stored	Off-Site	14%	Goes to	Disposal	Firm	
	DEMOLITION SCRAP	4				20	20	-	-	-	-	60	-	-	-	-	
	HEAT EXCHANGER CLEANINGS - SOLIDS	7	X	X	X	14	28	58	-	-	-	-	-	-	-	-	
	HEAT EXCHANGER CLEANINGS - LIQUIDS	10	X	X	X	-	-	-	-	-	10	-	-	10	-	80	

TABLE 3

SURVEY OF CURRENT (1985) REMOVAL, HANDLING, STORAGE, TREATMENT, DISPOSAL AND MONITORING PRACTICES

(Percentages refer to number of plants with waste or using a particular treatment or disposal method)

WASTE SOURCE (PLANT AREA)	NAME	REMOVAL AND HANDLING	STORAGE	TREATMENT AND DISPOSAL	MONITORING
I STORAGE AND HANDLING	Tank Bottoms - Leaded Gasoline	Manual, mechanical methods and vaccum truck removal used equally.	Usually put into buckets or drums for transport to disposal site, landfarming within tank compound is common practice.	Sludge is spread on impervious prepared bed and weathered for 2 to 4 months as per API procedure. Usually taken then to landfill. Three plants use part of landfarm for weathering, one goes to Stablex.	A check for organic lead will determine if weathering is complete. Landfarm disposal requires close control of lead levels. If landfill is used, leachate is incinerated or otherwise carefully disposed of.
	Tank Bottoms - Unleaded Gasoline	Manual, mechanical methods and vacuum truck used but mostly the latter.	Usually put into buckets or drums and taken to disposal site.	Landfill 47% Landfarm 38% Incineration 5% Tricil, Stablex 10%	Landfill - oil, metals and phenols checked regularly in leachate. Landfarm - complete soil and groundwater analysis at least 2 times per year.
	Tank Bottoms - Crude Oil	Most common method is by vacuum truck alone or combined with hot oil, solvent or water flush. A cutter stock such as hot cycle oil may also be added and recirculated to remove oil or waxy fraction.	Sludge may be stored on site temporarily until better weather.	Landfarm 50% Landfill 35% Incineration 5% Reclaimed 10% One plant sends sludge to outside reclaimer.	With landfarming, oil in soil and groundwater checked at least 2 times per year. Landfill requires oil, metal and phenol checks in leachate regularly.

TABLE 3 (cont'd)

SURVEY OF CURRENT (1985) REMOVAL, HANDLING, STORAGE, TREATMENT, DISPOSAL AND MONITORING PRACTICES

(Percentages refer to number of plants with waste or using a particular treatment or disposal method)

WASTE SOURCE (PLANT AREA)	NAME	REMOVAL AND HANDLING	STORAGE	TREATMENT AND DISPOSAL	MONITORING
I STORAGE AND HANDLING	Tank Bottoms - Distillates	Much the same as for crude tank sludges.	One plant fixates high PNA sludge with flyash before going to landfill.	Landfarm 60% Landfill 30% Reclaimed 5% Water Treatment system 5%	Same as for crude oil.
	Tank Bottoms - Decant	Vacuum truck is most common but semi-solid nature sometime requires front end loader or manual approach.		Landfarm 57% Landfill 43%	Same as for crude oil.
	Tank Bottoms - Bunker	Same as for crude sludges.		Landfarm 52% Landfill 34% Incineration 7% Recovered 7%	Same as for crude oil.
	Slop Tank Sludges	Vacuum truck is commonly used. Addition of cycle stock and dispersant used by one plant.		Landfarm 75% Landfill 25%	Same as for crude oil.
	Asphalt Wastes	Usually removed mechanically into drums, buckets and trucked to disposal.		Landfill 61% Recycled on-site 33% Incinerated 6% Several plants reclaim by means of "hot boxes".	

TABLE 3 (cont'd)

SURVEY OF CURRENT (1985) REMOVAL, HANDLING, STORAGE, TREATMENT, DISPOSAL AND MONITORING PRACTICES

(Percentages refer to number of plants with waste or using a particular treatment or disposal method)

WASTE SOURCE (PLANT AREA)	NAME	REMOVAL AND HANDLING	STORAGE	TREATMENT AND DISPOSAL	MONITORING
II PROCESS UNITS	Desalter Sludges	Vacuum truck is most common method. Manual methods also used. High pressure water used by two plants. Three plants report regular use of "sludge buster pump" greatly reduces clean-out problem.	One plant has decanter basin near desalter for sludge separation.	Landfarm 43% Landfill 34% Incineration 6% Recycled on-site 11% Tricil 6% Two plants recycle sludge either to slop or water treatment.	Same as for crude oil.
	Phenolic Caustic	Vacuum truck may assist in removal from vessels otherwise pumped or sewered.	Usually segregated in dedicated tanks. Mixed with sulphidic caustic for shipment in two plants.	Reclaimed 43% Water treatment system 33% Disposal Well 18% Incineration 6% Water treatment system requires neutralization to pH 9.0-9.5 before controlled injection. Acid oil content reclaimed.	Checked for acid oil and Be° before shipping in tank cars. If put into disposal well, pH and H_2S checked daily.
	Sulphidic Caustic	As above.	As above.	Reclaimed or recycled. 51% Water treatment system 33% Disposal Well 16% Three plants recycle into desalter for pH control while one goes to a pulp and paper mill.	If injected into water treatment or desalter, close control is required over pH.

TABLE 3 (cont'd)

SURVEY OF CURRENT (1985) REMOVAL, HANDLING, STORAGE, TREATMENT, DISPOSAL AND MONITORING PRACTICES

(Percentages refer to number of plants with waste or using a particular treatment or disposal method)

WASTE SOURCE (PLANT AREA)	NAME	REMOVAL AND HANDLING	STORAGE	TREATMENT AND DISPOSAL		MONITORING
II PROCESS UNITS	HF Acid (Neutralized)	Acid drained to sump and neutralized with caustic and/or lime spent caustic may be used.	CaF_2 clammed out of sump for disposal.	Landfill Disposal Well Water Treatment Sytem When landfilled, may be fixated with flyash.	43% 14% 43%	Fluoride content as well as pH of aqueous effluent must be closely controlled. Injected waste checked monthly with disposal wells.
	Sulphuric Acid (Spent)	Pumped into truck or rail car.		Reclaimed Stablex	75% 25%	Acid concentration checked before shipment.
	Clay (Spent)	Usually tower is steamed out and clay dropped into drums or buckets. Vacuum trucks can also be utilized.		Landfill Landfarm Incineration Stablex	53% 31% 8% 8%	Landfarm checked for oil, metals, pH, phenols and groundwater monitored. Landfill leachate checked for oil, phenols, heavy metals.
	Carbon (Spent)	Usually put into drums, buckets or dump trucks directly.		Landfill Landfarm Reclaimed Tricil/Stablex	68% 8% 8% 16%	Carbon analyzed before disposal.
	Amine Filters	Removed by vacuum truck or put into drums.		Landfill Landfarm	91% 9%	Usual monitoring carried out on landfills and landfarms.

TABLE 3 (cont'd)

SURVEY OF CURRENT (1985) REMOVAL, HANDLING, STORAGE, TREATMENT, DISPOSAL AND MONITORING PRACTICES

(Percentages refer to number of plants with waste or using a particular treatment or disposal method)

WASTE SOURCE (PLANT AREA)	NAME	REMOVAL AND HANDLING	STORAGE	TREATMENT AND DISPOSAL		MONITORING
II PROCESS UNITS	Off Specification Sulphur	Trucked or drummed.		Landfill Reclaimed Incinerated	58% 28% 14%	Landfill - leachate is incinerated because of possible acidity. When landfarmed, soil analysis is done regularly.
	Furfural (Spent)	Vacuum truck.		Incinerated	100%	
	Glycol (Spent)	Vacuum truck.		Incinerated	100%	
	Coke Fines	Removed by vacuum truck, manually or by dredging. Put into drums or buckets. One plant flushes fines to sewer system.		Landfill Reused Stablex	76% 12% 12%	Analysis done prior to disposal.
	Stretford Solution	Pumped into tanks.		Water treatment system	100%	
	E.S.P. Dust	Slurried and moved by vacuum truck.		Stockpiled		

TABLE 3 (cont'd)

SURVEY OF CURRENT (1985) REMOVAL, HANDLING, STORAGE, TREATMENT, DISPOSAL AND MONITORING PRACTICES

(Percentages refer to number of plants with waste or using a particular treatment or disposal method)

WASTE SOURCE (PLANT AREA)	NAME	REMOVAL AND HANDLING	STORAGE	TREATMENT AND DISPOSAL	MONITORING
II PROCESS UNITS	FCCU Dust	May be dropped into cement truck and water added to keep dust down. Enclosed trucks and drums also used.	Usually collected into special vessel at FCCU to facilitate removal.	Landfill 100%	Leachate from landfills checked for heavy metals.
	FCCU Catalyst (Spent)	Moved to disposal site in cement truck with water to keep dust down.	Usually stored on-site at FCCU.	Landfill 47% Sold 41% Landfarm 12%	If sold, carbon and heavy metals require analysis.
	Poly Unit Catalyst (Spent)	Put into drums, buckets or truck. Vacuum truck seldom used.		Landfill 42% Landfarm 30% Recycled 14% Stablex 14% One plant neutralizes before landfarming.	Soil need for phosphorous checked before landfarming.
	Hydrogen Plant Catalyst (Spent)	Usually put into buckets or drums with water spray.		Reclaimed 61% Tricil 13% Landfill 26%	If landfilled, leachate must be monitored for metals. One plant incinates leachate.
	Reformer Catalyst (Spent)	Screened into drums. Vacuum truck seldom employed.		Reclaimed 100% Catalyst base landfilled.	Platinum content checked before shipping.
	Hydrocracker Catalyst (Spent)	Dumped under N_2 blanket into buckets.		Landfill 40% Reused 40% Tricil 20%	One plant incinerates landfill leachate.

TABLE 3 (cont'd)

SURVEY OF CURRENT (1985) REMOVAL, HANDLING, STORAGE, TREATMENT, DISPOSAL AND MONITORING PRACTICES

(Percentages refer to number of plants with waste or using a particular treatment or disposal method)

WASTE SOURCE (PLANT AREA)	NAME	REMOVAL AND HANDLING	STORAGE	TREATMENT AND DISPOSAL	MONITORING
II PROCESS UNITS	Hydrotreater Catalyst (Spent)	Usually screened and drummed or put into buckets.		Reclaimed 53% Landfill 41% Stablex 6%	Prior check for heavy metals. One plant incinerates leachate from landfill.
	Merox Catalyst (Spent)	Pumped or sewered to spent caustic.	Usually sent to spent caustic tank. Occasionally segregated.	Disposal Well 25% Water treatment 25% Shipped with spent caustic 50%	Checked for Be°
	Copper Chloride Catalyst (Spent)	Manually dropped into lined drums.		Landfill 100%	Checked for metal analysis.
	Claus Plant Catalyst (Spent)	Put into drums, buckets or removed by vacuum truck.		Landfill 100%	
	HF Acid Soluble Polymer	Sewered to sump and neutralized with soda ash and/or lime.		Landfill 16% Incineration 16% Recycle 52% Water Treatment 16%	Checked for metal analysis.

TABLE 3 (cont'd)

SURVEY OF CURRENT (1985) REMOVAL, HANDLING, STORAGE, TREATMENT, DISPOSAL AND MONITORING PRACTICES

(Percentages refer to number of plants with waste or using a particular treatment or disposal method)

WASTE SOURCE (PLANT AREA)	NAME	REMOVAL AND HANDLING	STORAGE	TREATMENT AND DISPOSAL	MONITORING
III UTILITY PLANT	Cooling Tower Sludges	Most common removal is by vacuum truck. It may also be slurried and pumped into truck or drums.	Stored in c.w.t. sump. One plant collects sludge in storm pond.	Decanted water goes to water treatment. Sludge goes to: Landfill 69% Landfarm 31%	Sludge usually receives prior analysis especially for chromium. Soil is checked for pH, oil, phenols, sulphides, ammonia. Landfill leachate for same chemicals.
	Lime Sludge	Commonly run into basins or sumps. Water decanted. Removed by vacuum truck or mechanical means into buckets or drums in small plants.	Stored in ponds and thickened. More water decanted. Most plants run sludge directly to these ponds.	Landfill 72% Landfarm 21% Cement Plant 7% One plant has used a centrifuge successfully to reduce volume.	Sometimes analysis is done prior to disposal. Landfarms require soil analysis and groundwater check occasionally.
	Anthracite Filters	Removed manually or by mechical means into buckets or dump trucks.		Landfill 86% Landfarm 14%	Analysis done prior to disposal. Landfarm leachate checked regularly for oil, phenols and metals. Landfarms - soil and groundwater checked routinely.
	Spent Zeolite Resins	Removed mechanically into buckets or drums. Less often a vacuum truck is used. If the demineralizer resin is to be reclaimed, it is first washed.		Landfill 78% Landfarm 16% Reclaimed (Demin. Resin) 6%	Leachate checked for oil, phenols, metals. Groundwater and soil checked regularly.
	Sand from Filters	A vacuum truck is almost always used. Manual methods less frequently.		Landfill 55% Landfarm 45%	Groundwater and soil checked regularly. Waste also receives prior check in many plants.
	Ion Exchange Regenerant	Sewered.		Water treatment system 100%	Checked by one plant for hardness and chloride content.

TABLE 3 (cont'd)

SURVEY OF CURRENT (1985) REMOVAL, HANDLING, STORAGE, TREATMENT, DISPOSAL AND MONITORING PRACTICES

(Percentages refer to number of plants with waste or using a particular treatment or disposal method)

WASTE SOURCE (PLANT AREA)	NAME	REMOVAL AND HANDLING	STORAGE	TREATMENT AND DISPOSAL	MONITORING
IV WASTE WATER TREATMENT PLANT	Gravity Separator Sludge	Sludge is normally slurried and removed by vacuum truck. One plant uses clamshell. Two plants send sludge to thickener each shift.	One plant stores sludge in concrete basin along with other wastes. Water is decanted.	Landfarm 64% Landfill 24% Incineration 4% Reclaimed 4% Aerobic digestion 4%	Prior analysis usually done on sludge for oil, metals and phenols. Landfarm soil checked for pH and metals regularly. With landfill groundwater checked for oil and metals.
	I.A.F. and D.A.F. Sludge	Vacuum truck into thickener or holding tank commonest. Mechanical methods reported only by one plant.	Two plants reported holding tanks.	Landfarm 57% Landfill 8% Incineration 8% Water Treatment System 27%	Landfarm groundwater checked at least 3 times per year. Sludge composition once per month, especially for metals. Landfill leachate checked for pH, oil, phenol, sulphides, ammonia 3x/year.
	Biotreater Sludge	Vacuum trucks are commonest method of handling. Only one plant reported mechanical removal. One plant mixes sludge with clean soil.	Practices vary. Lagoons, thickeners may be used to reduce water content. One plant runs sludge into a tailings pond.	Landfill 19% Landfarm 81% One plant pumps sludge to sand drying bed to provide a dry cake. One uses a filter press.	Landfill leachate checked regularly for pH, oil, phenol, sulphides and ammonia. Landfarm soil and groundwater monitored at least 2 times per year.
	Storm Pond Silt	Vacuum truck almost always used. Mechanical removal into trucks not common. One plant uses a "mudcat" (A floating dredge system)	Some plants remove sludge from pond in winter.	Landfarm 60% Landfill 40%	Landfarm groundwater check at least 3x/yr for oil, metals, phenol. Landfill leachate checked for pH, oil, phenol, sulphides, ammonia 3x/yr. Sludge usually receives complete prior analysis.
	Sump Sludges	Same as for gravity separator sludge.	Same as for gravity separator sludge.	Landfarm 50% Landfill 35% Incineration 5% Reclaimed 5% Secure Landfill (TRICIL) 5%	Same as for gravity separator sludge.

TABLE 3 (cont'd)

SURVEY OF CURRENT (1985) REMOVAL, HANDLING, STORAGE, TREATMENT, DISPOSAL AND MONITORING PRACTICES

(Percentages refer to number of plants with waste or using a particular treatment or disposal method)

WASTE SOURCE (PLANT AREA)	NAME	REMOVAL AND HANDLING	STORAGE	TREATMENT AND DISPOSAL	MONITORING
V MISCEL-LANEOUS	Asbestos	Put into heavy plastic bags, usually labelled "DANGER ASBESTOS".	Wetted down during removal.	Landfill 100%	
	Refractory Brick	Put into buckets, either manually or mechanically.		Landfill 100%	
	General Refuse	Almost always stored in buckets, or bins removed by truck.		Landfill 100%	Visually inspected to eliminate asbestos, oil and contaminated soils.
	Oil Contaminated Soil	Usually removed by mechanical means such as backhoe or front-end loader into drums or buckets.		Landfill 48% Landfarm 48% Recycled on-site 4%	Usual landfill and landfarm monitoring.
	Used Drums	Drained, washed and stored.	Control area.	Reclaimed 76% Landfill 24%	
	Laboratory - Liquids	Either sewered to water treatment system or drained to drum or sump.	Collected into segregated drums usually. Aromatics segregated.	Water Treatment system 59% Recycled on-site 29% Incinerated 6% Deepwell disposal 6% May require neutralization before disposal.	Segregared waste liquids get checked prior to disposal.

TABLE 3 (cont'd)

SURVEY OF CURRENT (1985) REMOVAL, HANDLING, STORAGE, TREATMENT, DISPOSAL AND MONITORING PRACTICES

(Percentages refer to number of plants with waste or using a particular treatment or disposal method)

WASTE SOURCE (PLANT AREA)	NAME	REMOVAL AND HANDLING	STORAGE	TREATMENT AND DISPOSAL	MONITORING
V MISCEL-LANEOUS	Laboratory - Solids	Put into special drums, buckets or packaged for disposal.		Landfill 100%	
	PCB Wastes	Usually kept in special safe building.	Stored on-site. Stored off-site	Outside Disposal 14%	Containers checked regularly for leaks. Record kept.
	Demolition Scrap			Sold 60% Landfill 40%	
	Heat Exchanger Cleanings - Solids	Usually moved by vacuum truck or sometimes manually. In drums. Deposits removed by high pressure water with or without chemicals. Organic chemicals used for soaking of deposits.	Three plants have an area dedicated to cleaning bundles. Equipped with concrete pad, sump, etc. One plant stores scale on-site.	Landfarm 58% Landfill 42%	Solids receive routine check for oil, metals, pH phenols. Landfarming requires routine soil and groundwater checks.
	Heat Exchanger Cleanings - Liquids	Usually pumped or gravitated into holding tank before water treatment system. Vacuum truck rarely used.	One plant has vessel for neutralization of colgated liquids.	Water treatment system 80% Disposal well 10% Incineration (organic) 10% Neutralize to pH 9.0-9.5 before going to water treatment	Analysis carried out prior to disposal to determine procedure. Monthly check on injected waste for disposal wells.

4.0 RECOMMENDED IN-PLANT POLICIES AND PROCEDURES

4.1 HISTORICAL PERSPECTIVE

Prior to the mid-1970's there was very little technology and legislation respecting the disposal of wastes in Canada. As a result, municipalities and industries generally resorted to landfilling. The danger of leachate migration from an unsecured landfill site to the surrounding area was not well understood at that time. Broadly speaking, it is these old landfill sites which are the cause of most of the present day concern about groundwater contamination.

Open fields were sometimes used by both municipalities and industry for the disposal of various wastes. Years later it was found that these sites were contaminated and, in many cases building permits could not be acquired until the contaminated soil was physically removed. Site restoration to allow development has often proved to be costly.

Today, plant managers have come to realize that such short-term solutions are no longer acceptable socially, legally or economically. All provinces require some form of permit system for disposal both in plant or for transportation to an outside disposal facility. Failure to comply with such regulations can have serious repercussions on the company. "Pay now or pay later" is a very true statement today. If the provisions contained in this section are followed, problems in the future should be eliminated or greatly minimized.

4.2 RESPONSIBILITY

As a result of new knowledge and a changed social climate, some companies have laid down strict guidelines for responsibility and accountability for dealing with wastes on a "cradle to grave" basis. Most petroleum plants have a full-time environmental engineer or, in some cases, an individual who fills this role on a part-time basis. To assist that person in dealing with so many different waste materials, originating from a number of different operating departments, it is necessary that the plant have available a well understood procedure for waste control.

Some petroleum plants have established written procedures containing the following elements:

1. A well defined system of responsibilities and accountability at all organization levels.
2. Designation of one individual responsible for waste management in each plant who is accountable to the plant manager.

3. Identification of responsibility for investigating new plant waste management systems prior to plant construction.

4. Careful record keeping of all waste handling transactions and ultimate disposal including sale or exchanges.

5. Auditing performance of waste treatment sytems.

On page B-40 a sample model procedure for controlling refinery and upgrader waste materials is given. It is intended as a guide for assisting plants in developing their own written procedures.

On page B-42 a "Model Waste Disposal Control Form" is provided by way of example, Also, Section 4.5 on page B-43 shows a sample model record of waste material leaving the plant. The provincial manifest form might also be used for control purposes.

4.3 MODEL PROCEDURE FOR CONTROL OF PLANT WASTES

The following is a useful model of an in-plant policy for communicating company objectives and expectations to responsible personnel.

SAMPLE MODEL PROCEDURE FOR THE CONTROL OF REFINERY/UPGRADER WASTE MATERIALS

PURPOSE

- To ensure that all liquid and solid waste materials are disposed of in an environmentally acceptable manner which meets all regulatory requirements.
- To clearly define the various responsibilities for implementing this policy.

RESPONSIBILITIES

The plant manager will:

- Delegate to one individual within his plant the responsibility for waste disposal. This person will normally be the Environmental Engineer or the person who carries out such functions.
- Ensure that all waste material is disposed of in a manner that meets all regulatory requirements and does not create a nuisance or legal violation in transit or at the disposal site.
- Seek advice or guidance from his headquarter's staff when in doubt about the best course of action to follow.

The local Environmental Engineer or designate will:

- Keep a record of all wastes leaving the plant property or disposal within the plant including date of shipment, carrier, volume, destination, waste composition and identification of any toxic materials present in accordance with provincial regulations.

SAMPLE MODEL PROCEDURE FOR THE CONTROL OF REFINERY/UPGRADER WASTE MATERIALS

RESPONSIBILITIES (cont'd)

- Attempt to sell or recycle refinery waste to another industry using the Canadian Waste Materials Exchange, if necessary.
- Direct the disposal of all waste material to a government approved site ensuring that all necessary precautions have been taken during transit and that the carrier has government approval to carry such wastes.
- Maintain careful surveillance of all landfarm operations with particular attention to ground water monitoring and toxic chemical build-up in the soil. The landfarm should be operated in accordance with PACE and American Petroleum Institute recommendations.
- Ensure that all hazardous waste materials are stored in accordance with good practice and government requirements.
- Initiate studies on disposal problems in advance of plant changes so that appropriate disposal methods and locations can be arranged or further research can be completed in time.
- Make an inventory or record of past disposal methods, sites and materials to provide a preliminary assessment of potential problem areas.
- Report to local management any spills of a significant nature and arrange for their clean-up and safe disposal.
- Periodically submit a written report to the local manager highlighting significant events related to waste disposal.

4.4 MODEL WASTE DISPOSAL CONTROL FORM

The following is a representative model of a disposal control form that could be adapted for individual plant use.

MODEL WASTE DISPOSAL CONTROL FORM*

DATE ____________________

SOURCE OF WASTE ____________________

____

DESCRIPTION OF WASTE ____________________

____

____

QUANTITY OF WASTE ____________________

TRANSPORTED TO DISPOSAL SITE BY ____________________

____

DISPOSAL SITE LOCATION ____________________

____

FORM COMPLETED BY ____________________

* Please forward a copy of this form to the Environmental Advisor each time a waste material is disposed, whether inside or outside the refinery.

4.5 MODEL RECORD OF WASTE MATERIAL LEAVING PLANT

The following form is useful in tracking plant waste and can be used in conjunction with the manifest form.

SAMPLE MODEL RECORD OF WASTE MATERIAL LEAVING REFINERY/UPGRADER

DATE	SOURCE	WEIGHT or VOLUME	COMPOSITION	CARRIER	DESTINATION
05/06/86	API Separator	10 m^3	Oil 10% Solids 8% Water 82%	John Doe Transport Company	Refinery Landfarm

5.0 HAZARDOUS WASTE TRANSPORTATION

In Canada legislation governing the classification and transport of waste has only recently been introduced (1985) on a national basis with the Federal Transportation of Dangerous Goods Act and regulations taking the lead role. Many of the provinces are still in the process of developing parallel transport regulations, while at the same time many provincial environmental protection acts address the transport and storage of hazardous waste. In many cases, provincial regulations are being reviewed or being amended and the waste generator would be wise to contact the local regional office of the provincial agency to update himself on any changes to shipping or disposing of his hazardous waste.

The Federal Transportation of Dangerous Goods Act (TDGA) regulates the shipment of all dangerous commodities including hazardous wastes. This legislation covers all stages of handling and transport from the point of origin to the final destination and covers all transport modes -- air, rail, highway and marine.

In the case of waste transport the most likely carriers from a petroleum plant would be truck or rail cars. Transport is a shared legislative jurisdiction; rail transport is covered by federal acts, whereas road transport is covered by provincial transport legislation. Provinces have, or intend to adopt, comparable regulations under their respective transport acts. Industry has advocated common regulations among all provinces to permit ease of interprovincial movements.

In the case of international shipments, different requirements may apply. Since these regulations are presently under reciprocity negotiations and are subject to change, it is advisable prior to shipping wastes out of province or to a country such as the United States, to make appropriate inquiries of the responsible agencies. A compendium of such provincial and international agencies, giving telephone numbers, is provided in Section 5.1, page B-48.

It is the consignor's (shipper's) responsibility to classify the dangerous goods being shipped. He should consult Schedule II of the TDG regulations. In the case of hazardous waste the material may be listed or designated by law as hazardous or it may not be listed but still qualify as hazardous when subjected to the criteria detailed in Part III of the regulations. Table 4 on page B-46 identifies the listed wastes associated with petroleum plants. It identifies the waste by name, Product Identification Number (PIN), TDGR classification number and the packing group to which the material belongs.

In tracking wastes the Act requires that a system of vehicle placards and container labels be used as specified in Part IV of the Regulations by the carrier identifying the classification by hazard criteria in the form of pictorial symbols. It also requires that the waste be accompanied by a shipping manifest. A manifest is a shipping document that contains specific information that is useful in case of emergencies for the tracking of wastes to their ultimate destination. A sample manifest is shown on page B-47.

The completed manifest will contain information on the quantity of waste shipped, the name of the firm or individuals initiating the shipment, and information on the treatment and storage or disposal of the hazardous waste when it reaches its final destination. The form has three distinct sections to be filled in. The first section is the responsibility of the consignor (waste generator), the second of the carrier or transporter and the third of the consignee (receiver). Six copies are completed with two copies forwarded to the control agency and file copies retained for a period of two years. A typical distribution of the manifest copies is as follows:

	SENT TO	SENT BY/ACTION
COPY 1	Regulatory Agency	Generator
COPY 2	Generator	(Retains for 2 years)
COPY 3	Regulatory Agency	Receiver
COPY 4	Carrier	(Retains for 2 years)
COPY 5	Receiver	(Retains for 2 years)
COPY 6	Generator	Receiver

In certain provincial jurisdictions, vehicles used to transport waste require certificates of approval or licensing, assuring they meet standard of construction and operation. Driver training in vehicle operation, waste management legislation, environmental and occupational health concerns pertaining to the waste being transported and initial emergency response procedures are also mandatory. The Canadian Standards Association (CSA) has developed preliminary standards for pressure/vacuum liquid waste tanks and for reinforced plastic highway tanks for the transportation of hazardous wastes. These preliminary standards are CSA B338-1982 and supplement No. 1-1984 and are included in the bibliography, Part C, Appendix 7.

To assist petroleum plant personnel responsible for waste shipment and disposal to sort through the complexity of TDG Regulations and the complimentary provincial Waste Management Regulations to classify and manifest their waste correctly, decision trees are available in most cases from the appropriate regulatory agency.

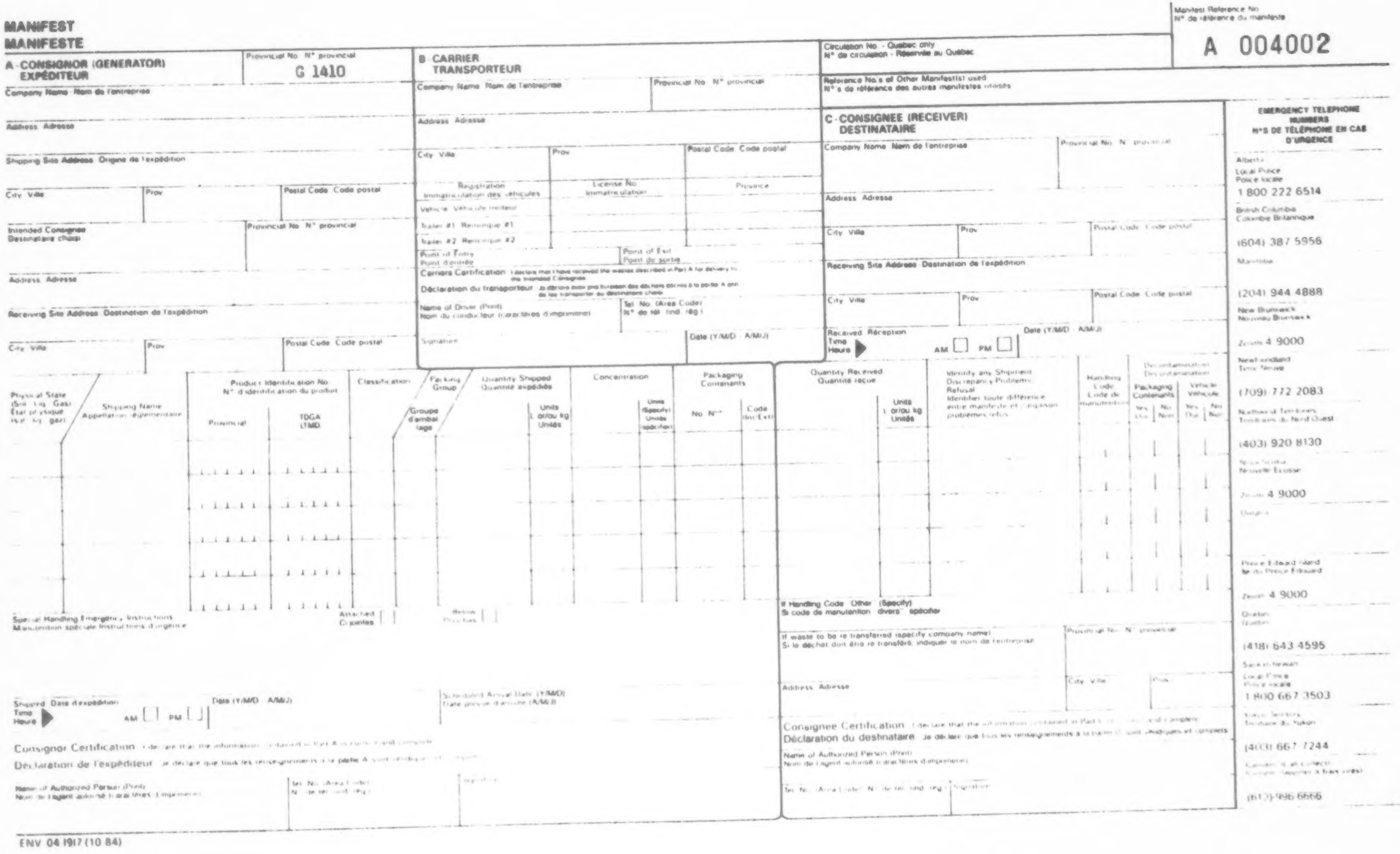
TABLE 4

TRANSPORTATION OF DANGEROUS GOODS ACT - HAZARDOUS WASTE CLASSIFICATION

PETROLEUM PLANT WASTES

PRODUCT IDENTIFICATION NUMBER (PIN)	WASTE TYPE NUMBER	SHIPPING NAME/DESCRIPTION	TDGR CLASSIFICATION	PACKING GROUP
9374	74	Dissolved Air Flotation (DAF) float	3.1	II
9375	75	Slop oil emulsion solids	6.1	II
9376	76	Heat exchanger bundle cleanup sludge	6.1 8	II
9377	77	Gravity separator (API) sludge	3.1 6.1	II
9378	78	Leaded tank bottom sludges	6.1	II
9379	79	Coker - ammonia still lime sludge	9.3	III
9397	97	Coker - decanter tank tar sludge	6.1	II

FIGURE 6 - SAMPLE OF FEDERAL TDGR MANIFEST FORM



MANIFEST
MANIFESTE

Manifest Reference No / N° de référence du manifeste: A 004002

A - CONSIGNOR (GENERATOR) / EXPÉDITEUR

Provincial No / N° provincial: G 1410

Company Name / Nom de l'entreprise

Address / Adresse

Shipping Site Address / Origine de l'expédition

City / Ville | Prov | Postal Code / Code postal

Intended Consignee / Destinataire choisi | Provincial No / N° provincial

Address / Adresse

Receiving Site Address / Destination de l'expédition

City / Ville | Prov | Postal Code / Code postal

B - CARRIER / TRANSPORTEUR

Company Name / Nom de l'entreprise | Provincial No / N° provincial

Address / Adresse

City / Ville | Prov | Postal Code / Code postal

Registration / Immatriculation des véhicules	License No / Immatriculation	Province
Vehicle / Véhicule moteur		
Trailer #1 / Remorque #1		
Trailer #2 / Remorque #2		

Point of Entry / Point d'entrée | Point of Exit / Point de sortie

Carriers Certification: I declare that I have received the wastes described in Part A for delivery to the Intended Consignee.

Déclaration du transporteur: Je déclare avoir pris livraison des déchets décrits à la partie A afin de les transporter au destinataire choisi.

Name of Driver (Print) / Nom du conducteur (caractères d'imprimerie) | Tel. No. (Area Code) / N° de tél. (ind. rég.)

Signature | Date (Y/M/D - A/M/J)

Circulation No. - Quebec only / N° de circulation - Réservé au Québec

Reference No.'s of Other Manifest(s) used / N°'s de référence des autres manifestes utilisés

C - CONSIGNEE (RECEIVER) / DESTINATAIRE

Company Name / Nom de l'entreprise | Provincial No / N° provincial

Address / Adresse

City / Ville | Prov | Postal Code / Code postal

Receiving Site Address / Destination de l'expédition

City / Ville | Prov | Postal Code / Code postal

Received / Réception Time / Heure ▶ AM ☐ PM ☐ | Date (Y/M/D - A/M/J)

Physical State (Sol. Liq. Gas) / État physique (sol. liq. gaz)	Shipping Name / Appellation réglementaire	Product Identification No / N° d'identification du produit: Provincial	TDGA / LTMD	Classification	Packing Group / Groupe d'emballage	Quantity Shipped / Quantité expédiée: Units / L or/ou kg / Unités	Concentration: Units (Specify) / Unités (spécifier)	Packaging Containers: No / N°	Code (Int/Ext)	Quantity Received / Quantité reçue: Units / L or/ou kg / Unités	Identify any Shipment Discrepancy Problems Refusal / Identifier toute différence entre manifeste et cargaison problèmes refus	Handling Code / Code de manutention	Decontamination / Décontamination: Packaging Containers: Yes / Oui	No / Non	Vehicle / Véhicule: Yes / Oui	No / Non

Special Handling Emergency Instructions / Manutention spéciale Instructions d'urgence

Attached / Ci-jointes ☐ Below / Ci-dessous ☐

Shipped / Date d'expédition Time / Heure ▶ AM ☐ PM ☐ | Date (Y/M/D - A/M/J) | Scheduled Arrival Date (Y/M/D) / Date prévue d'arrivée (A/M/J)

Consignor Certification: I declare that the information contained in Part A is correct and complete.

Déclaration de l'expéditeur: Je déclare que tous les renseignements à la partie A sont véridiques et complets.

Name of Authorized Person (Print) / Nom de l'agent autorisé (caractères d'imprimerie) | Tel. No. (Area Code) / N° de tél. (ind. rég.) | Signature

If Handling Code "Other" (Specify) / Si code de manutention "divers" spécifier

If waste to be re-transferred (specify company name) / Si le déchet doit être re-transféré, indiquer le nom de l'entreprise | Provincial No / N° provincial

Address / Adresse | City / Ville | Prov

Consignee Certification: I declare that the information contained in Part C is correct and complete.

Déclaration du destinataire: Je déclare que tous les renseignements à la partie C sont véridiques et complets.

Name of Authorized Person (Print) / Nom de l'agent autorisé (caractères d'imprimerie)

Tel. No. (Area Code) / N° de tél. (ind. rég.) | Signature

EMERGENCY TELEPHONE NUMBERS
N°S DE TÉLÉPHONE EN CAS D'URGENCE

Alberta Local Police / Police locale	1 800 222 6514
British Columbia / Colombie Britannique	(604) 387 5956
Manitoba	(204) 944 4888
New Brunswick / Nouveau Brunswick	Zenith 4 9000
Newfoundland / Terre Neuve	(709) 772 2083
Northwest Territories / Territoires du Nord Ouest	(403) 920 8130
Nova Scotia / Nouvelle Écosse	Zenith 4 9000
Ontario	
Prince Edward Island / Île du Prince Édouard	Zenith 4 9000
Quebec / Québec	(418) 643 4595
Saskatchewan Local Police / Police locale	1 800 667 3503
Yukon Territory / Territoire du Yukon	(403) 667 7244
Canutec (call collect) / Canutec (appelez à frais virés)	(613) 996 6666

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5.1 LIST OF AGENCIES INVOLVED IN HAZARDOUS WASTE TRANSPORT

The following is a list of agencies, their addresses and phone numbers for making inquiries regarding transboundary shipments of wastes.

INTERNATIONAL SHIPMENTS

Environmental Protection Service
Environment Canada
Place Vincent Massey Building
351 St. Joseph Boulevard
HULL, Quebec K1A 1C8
(819) 997-3376

PROVINCIAL/TERRITORIAL SHIPMENTS

Alberta
Public Safety Services
10320 - 146 Street
EDMONTON, Alberta T5N 3A2
(403) 427-2772

Alberta
Pollution Control Division
Alberta Environment
9820 - 106 Street
EDMONTON, Alberta T5K 2J6
(403) 427-5868

British Columbia
Waste Management Branch
Ministry of Environment
Parliament Buildings
VICTORIA, British Columbia V8V 1X5
(604) 387-4321

Manitoba
Department of Environment Workplace Safety & Health
Environmental Management Division
Box 7, Building 2 - 139 Tuxedo Avenue
WINNIPEG, Manitoba R3N 0H6
(204) 944-9888

New Brunswick
Environment New Brunswick
P.O. Box 6000
FREDERICTON, New Brunswick E3B 5H1
(506) 453-2861

Newfoundland
Department of Environment
Elizabeth Towers, Elizabeth Avenue
ST. JOHN'S, Newfoundland A1B 1R9
(709) 737-2559

Northwest Territories
Pollution Control Division
Department of Renewable Resources
Box 1320
YELLOWKNIFE, NWT X1A 2L9
(403) 873-7654

Nova Scotia
Department of Environment
P.O. Box 2107
HALIFAX, Nova Scotia B3J 3B7
(902) 424-5300

Ontario
Waste Management Branch
Ontario Ministry of the Environment
135 St. Clair Avenue West
TORONTO, Ontario M4V 1P5
(416) 965-6191

Prince Edward Island
Department of Community Affairs
P.O. Box 2000
CHARLOTTETOWN, P.E.I. C1A 7N8
(902) 892-0311

Quebec
Ministry of the Environment
Land Division
3900 rue Marly
SAINTE-FOY, Quebec G1X 4E4
(418) 643-4336

Saskatchewan
Department of the Environment
Waste Management Division
3085 Albert Street
REGINA, Saskatchewan S4S 0B1
(306) 787-5811

Yukon
Transport Services Administrator
Department of Community and Transportation Services
P.O. Box 2703
WHITEHORSE, Yukon Y1A 2C6
(403) 667-5833

6.0 WASTE TREATMENT TECHNOLOGIES AND DISPOSAL METHODS

6.1 INTRODUCTION

Current technology applied to waste treatment and disposal is fairly basic. An understanding of these processes and their limitations is essential for industry personnel involved in the waste management field.

The term "treatment" as used here refers to any activity that eliminates or reduces the volume or hazardous nature of a waste, preparing the waste for disposal. Basically there are three types of treatment available, namely; physical/chemical, thermal and biological. All three are used and will be discussed in this section.

"Disposal", which is largely self-explanatory, usually takes the form of landfill or deepwell disposal.

Landfilling is used for the ultimate disposal of the bulk of wastes produced by petroleum plants. Disposal wells are also used where geological conditions are favourable.

In California under the impetus of tough legislation, the oil industry through the Western Oil and Gas Association (WOGA) has launched a multi-phase research effort to uncover new technologies to replace land treatment of oily wastes. Some of the alternatives being researched may prove technically sound, but there is every indication that the attendant costs of these technologies will be very high. Source reduction will in future, therefore, assume a greater importance than it has in the past.

This section will deal with the following treatment technologies and disposal methods:

- Land treatment (landfarming)
- Waste Water Treatment Systems
- Oil Recovery from Oily Sludges
- Landfill
- Leaded Gasoline Sludge Disposal
- Incineration
- Deep Well Disposal
- Chemical Fixation

6.2 LAND TREATMENT (LANDFARMING)

GENERAL

Landfarming is a disposal process which utilizes natural soil bacteria to break down oily or biological sludges. Photo-oxidation and volatilization also play a significant role.[1] The bacteria use the organic part of the waste as a food, producing carbon dioxide and additional bacteria cells in the process. Landfarming is also known by other names such as landspreading, soil biodegradation, etc. but should not be confused with landfilling.

6.2.1 Design and Selection of Sites

The site should be fairly level and the groundwater level should be at least one or two metres (3-6 feet) below grade. A loam type soil is ideal but not always available. Clay soils tend to retain water, exclude oxygen and are difficult to till. Sometimes tiles are required to drain the site. Very sandy or silty soils may have a low cationic exchange rate or ability to absorb heavy metals. A low point in the landfarm may be required to accumulate surface run-off but this will depend on rainfall rates. Normally, the collected surface run-off will contain only very small amounts of oil or a visible sheen. A berm may be needed around the site and a drainage system may be provided to the waste water treatment system.

6.2.2 Operating Parameters

Landfarming is a process and, therefore, best results will be obtained when the process is understood and controlled. The oily sludge is concentrated in the top 15 cm (6 inches) or so of soil.[1] Biodegradation requires oxygen, moisture, and nutrients such as nitrogen and phosphorous in much the same way as a bio-treater does (C:N:P. at 100:10:1). The API Manual on Disposal of Refinery Wastes[2], provides a nomogram for determining the amount of nutrients or fertilizer needed for degradation of a given amount of oil.

Soil temperature cannot be controlled. Since the bacteria are most active in the 10-47°C range (50-116°F)[1], landfarm operations should be undertaken only during the warm months.

The optimum pH range is 6-8. Lower pH ranges tend to increase metal solubility and therefore increase groundwater contamination[2]. Limestone addition to acidic soils can be beneficial.

One of the most important factors is oxygen availability, particularly if the soil contains clay. Oxygen can be supplied to the soil by rotatilling, disking, harrowing, etc. A rotatiller attached to the rear of a farm tractor equipped with a power take-off is frequently used. A shield over the rotatiller can reduce dust from the operations. Rotatilling approximately every two weeks will generally be sufficient until the oil level in the soil decreases to 2% or 3%.[2]

The presence of excessive levels of heavy metals decreases bacterial activity. There is very little coherent data in the literature concerning the effects of heavy metals on soil microorganisms. This is because the degree to which these metals are adsorbed on clay and soil organics is variable.

A PACE study[1] showed levels of heavy metals that were toxic to bacterial populations as follows:

	TOXIC CONCENTRATIONS	AUTHOR
Silver and Mercury	1 ppm	Drucker et al 1974
Mercury	100 - 500 ppb	Stratton 1978
Cadmium	1 - 20 ppm	Stratton 1978
Cadmium	100 ppm decreasing nitrate utilization	Wallum 1973
Chromium	0.5 - 2 ppm depending on valency	National Research Council of Canada 1976.

6.2.3 Application

Since landfarming is not carried out during the winter months, some type of lined pit, steel tank or concrete basin should be provided to safely stockpile sludges accumulated during the cold or wet weather.

A specially equipped truck with some type of horizontal distributor pipe is generally employed for spreading wastes. Where distances are short a fire hose connected to a fixed piping system has been used. The main objective is an even application to the soil. Heavier sludges may have to be hauled in a dump truck and spread by a grader or bulldozer. Sludges can be injected a few inches below grade to prevent odours but special equipment is needed.

The initial oil in soil level can be as high as 5 to 10%. Levels above this tend to starve the bacteria for oxygen. It is best to apply the sludge at least three or four times during the summer rather than all at once. If this is done under ideal conditions, up to 230 m^3/hectare (580 bbls/acre) may be degraded in one season(1) depending upon temperature, oil composition, type of soil, etc. The most readily oxidized hydrocarbons are n-paraffins (C_9 - C_{18}) followed by branched alkanes, n-paraffins (C_5 - C_8) with ringed compounds are the most difficult to degrade.

6.2.4 Wastes Amenable to Landfarming

A number of refinery wastes that may be landfarmed are as follows:

1. Gravity Separator sludges present no particular problem since the heavy metal levels are low.

2. Crude Tank Bottoms - usually no problem.

3. Bunker Tank Bottoms - reduced application rates are required since the oils degrade slowly because of their chemical composition.

4. Gasoline Tank Bottoms - the sludges may contain high concentrations of cresol derivatives found in gasoline additives. The cresol like materials should be washed out and destroyed in a bio-treater under controlled conditions. The sludges can be landfarmed.

5. Cooling Tower Sludges - care should be taken to ensure that the soil bacteria are not affected by corrosive inhibitors (chromium and zinc compounds) that may be used in the circulating cooling water system.

6. Storm Pond Silt - should be no problem.

7. Biological sludges - odours should not be a problem with properly stabilized sludge (20-30 days aeration). No nutrients should be needed as only the "bones" containing nutrients are present in the sludge. A loading of 50 tonnes per hectare per year (20 tons/acre) can be tolerated. Soil aeration is not critical, however, non-stabilized sludge does require aeration.

6.2.5 Monitoring

Before a landfarm site is established it is essential to apply for a permit and to supply pre-operational data. For example:

- Plot plan showing slopes, catchment area, and berms if required.
- Road access, security arrangements, etc.
- Bore holes results, e.g. water table level and analysis of water for oils, phenols, heavy metals, etc.
- Proposed application rates for specific wastes.

All of the provinces require post operational monitoring which is site specific. This usually involves establishment of a suitable number of groundwater monitoring wells depending on the size and location of the site. In addition, monthly or quarterly analysis for hydrocarbons, phenols and heavy metals as well as any other chemicals of concern is usually required.

Soil analysis should be carried out periodically to monitor the oil content of the soil and to ensure that heavy metals have not built up to the point where they become toxic to soil bacteria.

REFERENCES

1. PACE Report No. 81-5A "Landspreading of Sludges at Canadian Petroleum Facilities."
2. American Petroleum Institute "Manual on Disposal of Refinery Wastes", Section 7.

6.3 WASTE WATER TREATMENT SYSTEMS

6.3.1 General

Waste water treatment systems as installed in refineries generally consist of some type of segregated sewer system, equalization basins, gravity separation, intermediate treatment such as sand filtration, followed by biotreatment or its equivalent. Some plants may use tertiary polishing of the effluent. Storm or surface water is generally segregated.

6.3.2 Background

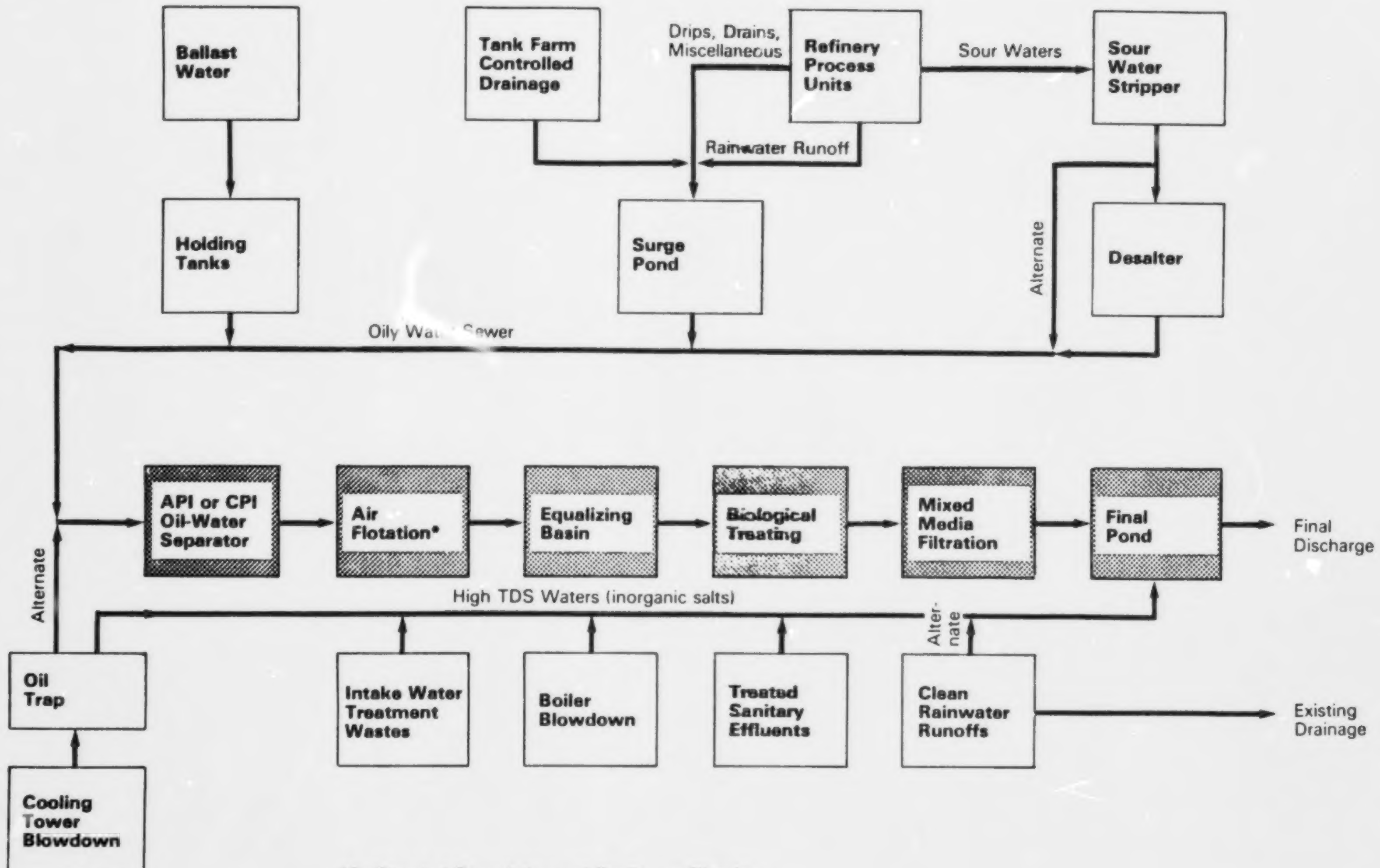
In Canada, most provinces have adopted "Federal Regulations and Guidelines for Petroleum Refineries" made under the Fisheries Act as their basic requirements. Some provinces have imposed somewhat more restrictive regulations. The legislation generally establishes an emission level for oil, phenol, ammonia, suspended solids, sulphides and pH, based on refining charge rate. New refineries or process additions made after 1973 must meet loadings which are roughly 50% of those for plants prior to this date. All plants are expected to meet a 96 hour trout survival test to assure that acute toxicity does not exist.

The result of this legislation is that most refineries have installed rather sophisticated water treatment systems with a great deal of resilience to shock loadings. These systems are capable of destroying a number of wastes provided they are pre-treated and injected at a controlled rate. A flow diagram of a typical treatment system is included in this chapter (see Figure 7, page B-55).

6.3.3 Liquid Wastes Amenable to Disposal in Waste Water Systems

Modern effluent treatment systems have the ability to treat a large number of common refinery waste materials. A few examples are as follows:

FIGURE 7 - WASTEWATER SOURCES AND WASTEWATER MANAGEMENT IN A REFINERY



*Or Chemical Coagulation and Settling or Filtration

1. I.A.F. and D.A.F. Float

This waste is frothy in nature and will contain small amounts of oil and solids but mostly water. The range of composition is shown on Waste Data Sheet IV-2, Part A, in this manual. The scum is usually introduced into the separator forebay on a controlled basis where it soon becomes dispersed in the water phase. The oil content is therefore recovered. No tendency to recycling of the oil or suspended solids in the separator has been noted to date.

2. Phenolic Caustic Solution

The treatment of certain gasoline components such as heavy catalytically cracked gasoline with caustic results in a spent caustic containing various phenolic and cresylic compounds. In many cases the spent caustic from such sources can be shipped to a chemical plant where the cresols can be "sprung" and used to make phenolic resins. In other areas, it may not be economical to do so and some other method must be found.

Caustic soda containing phenols and cresols may be injected into the reactor of a biotreater on a continuous basis and at very low rates after neutralization to pH 9.0 with sulphuric acid. Calculations may be useful but the best approach is an actual controlled injection program in which the reactor pH as well as the phenol in the effluent are carefully monitored for changes. Other parameters should be carefully watched.

3. Sulphidic Caustic Solution

Lighter hydrocarbon fractions such as propane, butane, naptha and light catalytically cracked gasoline require a caustic wash to remove hydrogen sulphide and mercaptans. This material can also be injected into a biotreater as long as it is done carefully at low rates of flow. This waste may be combined with phenolic caustic before injection. If neutralization with acid is first carried out, care should be taken with the deadly hydrogen sulphide which can evolve.

4. Tank Bottoms

Tank bottoms from leaded gasoline and distillates often contain small amounts of water, caustic and phenolic materials usually from inhibitors. Since the phenol concentration can run into several thousand parts per million, complete analysis is required before injection. Again, controlled injection is required for success.

5. Ion Exchange Regenerant

Such wastes generally contain high concentrations of sodium chloride unreacted during the zeolite regeneration. Since bacteria in a biotreater can be shocked by sudden changes in chloride level, care should be taken to inject this material on a controlled basis.

6. Heat Exchanger Cleaning Liquids

These liquids may be either alkaline or acidic depending upon their applications. Where lime scale is to be removed from exchangers, inhibited sulphuric acid is generally used. Some refineries have set aside a specific area in the plant with collection facilities for the spent cleaning liquids. Direct injection of these wastes into the sewer system should be avoided because the acid can seriously damage any concrete with which it comes in to contact. The acid or caustic can cause upsets in the pH of the waste water treatment system thereby increasing emissions of oil, phenols, etc. Before injecting these wastes into the treatment system, they should be carefully neutralized to pH 7-9. These wastes are "listed" under U.S. EPA regulations.

7. Stretford Solution

This waste may be bled slowly into the waste water treatment system.

8. Merox Catalyst Liquid

The catalyst is generally present in a caustic media and may also appear in the bottom of the rundown tanks. The pretreatment is the same as for spent caustic, namely neutralization followed by injection on a controlled basis into the effluent treatment system.

6.4 OIL RECOVERY FROM OILY SLUDGES

6.4.1 General

Sludges containing appreciable amounts of oil originate from various parts of petroleum plants such as sumps, gravity separators, and various types of storage tanks. This section will discuss a number of techniques which may be used to recover or recycle the oil fraction which has a commercial value. At the same time, the amount of waste which must be disposed of will be reduced as a side benefit.

6.4.2 Background

The API Manual[1] on Disposal of Refining Wastes points out that the oil content of wastes to be landfarmed should not exceed 15% in order to reduce land area required for disposal.

It is worthwhile to consider some economic factors involved in removing and disposing of, say, 15cm (6 inches) of sludge containing 43% oil (PACE[2]) from a crude tank 55 metres (180 feet) in diameter. The sludge layer will contain 153 cubic metres of oil (864 bbls) with a value of $14458 at $15/bbl (1986). If we add to this the cost of landfarming this waste at $15.00/tonne in 1986 ($9.10/ton in 1980) the disposal cost alone becomes another $5336. The total value of the oil portion plus the disposal cost becomes $19794 in 1986 dollars.

It is apparent, therefore, that the economics of recovery must be looked at before considering disposal. On the other hand, a study done for Western Oil and Gas Association[3] stated that "many evaluations have concluded that one "typical" refinery generally does not produce sufficient sludge to operate a sludge dewatering system enough hours per year to provide an adequate return on investment."

A number of outside contractors will contract to accept oily sludges and to dispose of them. Before entering into such a contract a thorough inspection of the proposed recovery process should be made to ensure that the capability does exist. Some of the concerns regarding use of outside contractors are:

- Acceptability of process to provincial environmental authorities.
- Does the contractor have a valid permit to process this particular waste?
- Are the employees of the contractor properly protected against contact with hazardous materials which may be present? This is important where plate and frame filters must be cleaned.
- Does the contractor use acid to reduce pH prior to treatment? This can release deadly H_2S from the sludge.
- What legal liability will the producer of the sludge incur if something goes wrong with the contractor's process?

6.4.3 Oil Recovery Methods

The following is a description of physical/chemical and mechanical oil separation techniques applied to oily sludges:

1. Use of Hot Oil

   Hot recycle oil can be injected into the bottom of the pumped down tank to dissolve waxy and gelatinous tank deposits. Much of the oil in the sludge can thus be recovered by recycling to the crude unit or FCCU. In one variation, a steam heated exchanger located in the tank compound provides the heat supply. To enhance the operation, tank mixers may be turned on during the time the hot oil is being recirculated. Care must be taken not to heat the oil beyond its flash point.

2. Solvent Extraction

There are a number of companies offering patented processes for the recovery of oil. The chemical companies, which specialize in emulsion breaking chemicals, usually offer an engineering service directed at maximizing the recoverable oil fraction.

Most refineries already practice oil recovery in one form or another, particularly with slop oils. Many techniques are involved in resolving these emulsions. Simple gravity separation, use of chemicals, heat, and the use of lighter oils and solvents to thin the heavier fractions, are all used alone or in combination.

The B.E.S.T. process[3] uses triethylamine to extract organics from oily sludges. This process is reported capable of producing a high quality oil with less than 1% BS&W, a solid with less than 0.2% water and a liquid with less than 500 mg/litre T.O.C. Experiments are being carried out in California with a 100 T/D test unit.

3. Recycling Oily Sludge to a Coker

The API[6] reports that some refineries are using their coker units to dispose of certain types of sludge containing oil. The report states that 5% of the reporting refineries dispose of API separator sludge, 7% D.A.F.Float, and 3% Slop Oil Emulsion Solids in this manner. Mobil Oil in the U.S.A. practices this technique with a Delayed Coker. Exxon uses a Fluid Coker.

Recycling in this manner has many advantages over conventional methods of recovery, however, its application is very limited. In Canada, only 3 Delayed Cokers and 1 Fluid Bed Coker were reported to be in operation in 1983 according to PACE.[7]

4. Variable Angle Mixers

At a premium of 10-20% over conventional mixers, variable angle tank mixers can be installed to stir up tank bottoms thereby reducing the volume of sludge to be removed. By slurrying the bottom residue recycling is possible.

The principle is very simple. The ordinary tank mixer is installed so that the shaft is off tank centre by a few degrees. The variable angle mixer swings back and forth through an arc of about 45° over an eight hour period. The result is much improved mixing of the tank bottoms.

The advantages of these mixers over conventional mixers are said to be:

- Can be installed in same manway using same amount of electrical power as a conventional mixer.

- Reduced power costs because they do not have to be operated as frequently as conventional mixers.

- A big reduction in the amount of sludge to be removed, thereby reducing labour costs.

- Recovery of most of the valuable oil fraction.

5. Jet Tank Cleaners

Exxon Research and Engineering[4] developed a rotating jet which is placed in the centre of the tank. In many ways this resembles a rotating lawn sprinkler. In large tanks more than one jet is required. A recirculation pump takes suction on the tank and provides the energy for the rotating jets. These jets were used in several large crude storage tanks of 500,000 bbl. size in Ireland with amazingly good results. Power savings are very significant. A variation of the jet location is available for existing tanks. The jets are attached to the tank manways and perform in the same way, although more units will be required.

6. Rotary Vacuum Filters

Rotary vacuum filters consist of a horizontal compartment drum supporting the filter media on its outer surface. The drum is rotated partially submerged in a tank containing the sludge. As each section of the drum passes through the tank, a vacuum is applied pulling the liquid inward but retaining the solids on the surface. Th cake is removed by a scraper blade.

For oily sludges it may be necessary to add inert solids to the feed equal in amount to the solids in the waste. If the feed tends to clog the filter media, a precoat may be needed to increase filtration rates. This precoat can last from 10 hours to several days before it must be replaced. The filter cake has a high solids content.

Energy requirements are modest. For a $100M^3$/day machine handling four tonnes of solids, only 14KW is needed.[5] Rotary vacuum filters are widely used in municipal waste treatment plants for filtering biosludge, usually with the help from a conditioner such as alum or polymers.

7. Scroll Type Centrifuges

The scroll centrifuge consists of a horizontal or vertical bowl. A helical conveyor called the scroll or screw inside the bowl rotates 75-100 revolutions per minute slower than the bowl. The solids are forced against the inside of the bowl and are propelled towards the discharge end.

The scroll centrifuge has a relatively high feed rate with a low gravity-force. This is the type of centrifuge most often used by petroleum plants. The effluent may still contain residues requiring further treatment. The cake has a high solids content and may not be pumpable.

The durability of centrifuges has been greatly improved in the last few years with the introduction of tungsten carbide surfacing. One refinery in California[3] has operated a two-stage centrifuge system for 15 years. Centrifuges are generally operated for a short term of one to three weeks at a time. To date, neither heat or chemicals have been found necessary to optimize performance. These machines seem to run best at 40-60% of rated capacity. Very often a centrifuge is needed as a first stage reduction followed by a plate and frame filter capable of removing small amounts of residual solids.

Energy requirements run from 60-240 KW per cubic metre/minute of waste feed.

Centrifuges offer a viable alternative where the volume of oily sludge warrants oil recovery.

8. Gravity Belt Filters

This process depends upon the use of high molecular weight polymers to coagulate the sludge. After mixing, the sludge is poured onto a porous moving belt where free water drains through. The sludge is then pressed between two moving belts forcing the oil and water through the belt. The openings are much less likely to plug because the polymer has conditioned the sludge.

Gravity belt filters undergo less wear and tear than centrifuges because the parts are moving more slowly. The disadvantage is that high-cost polymers are needed and these are sensitive to pH and other changes in the sludge. The solids cake is relatively dry and firm. Heat will tend to improve the separator process.

Electricity requirements for a 20-50 US GPM machine are about 18 KW[5]. A 60 US GPM water supply is needed as well.

Preconditioning the pH may result in the production of hydrogen sulphide emissions. There may also be a problem with hydrocarbon emissions requiring a vented hood.

Gravity belt filters are a relatively new technology as applied to petroleum plants. They have been used in Europe for dewatering of biosludges for many years.

REFERENCES

1. American Petroleum Institute "Manual on Disposal of Refinery Wastes", Volume III.
2. PACE Report No. 80-4 "Canadian Petroleum Refining Industry Waste Survey", 1980.
3. Western Oil and Gas Association "Study of Alternative Technologies to Land Disposal" by Mittelhauser Corp., El Toro California, October 18, 1985.
4. Exxon Research and Engineering, Florheim Park, New Jersey.
5. Ontario Waste Management Corporation "Generic Process Technology Studies", 1982.
6. American Petroleum Institute "1982 Refinery Solid Wastes Survey" by Environmental Resources Management Incorporated, West Chester, Pennsylvania 19280.
7. PACE Report No. 85-1 "Canadian Petroleum Refineries Atmospheric Emissions Survey", 1983.

6.5 LANDFILL

6.5.1 General

There is no disposal option known to handle such large volumes and varieties of waste as cheaply as landfilling. For petroleum plant wastes, it remains the most common method of ultimate disposal. At the same time, no form of disposal has evoked such a wide public concern. This public concern generally stems from the threat posed to the quality of groundwater at, adjacent to, or even a considerable distance from, such sites.

Much of this concern is based on experience with badly designed or mismanaged landfill operations. Today, care should be taken to distinguish between a secure landfill, a sanitary landfill and a small town dump site when deciding on an appropriate site for industrial plant wastes.

A secure landfill means the burial of a waste, generally in containers, at a geologically chosen site, groundwater protected by clay or plastic barriers, with a leachate collection system, and a groundwater monitoring system. A sanitary or municipal landfill is the burial of non-hazardous waste, such as domestic refuse, without the benefit of liners or a leachate collection system.

A secure landfill is essentially a well engineered, well operated, and environmentally safe disposal system. Unfortunately, not all landfills can meet such strict criteria and therein lies the reason for public concern.

6.5.2 Site Selection

No site should be used for landfilling unless the geological and hydrogeological conditions have been investigated and found to be environmentally satisfactory. This investigation will include elevations of the water table, direction of underground water movement with gradients, quality of existing ground water at and around the site, as well as soil strata, location of bed rock, surface drainage, etc. In no case should a landfill site be even considered if it intrudes into a fresh water aquifer which is being or may be used for a potable water supply. In selecting a site for a central industrial waste disposal plant in Ontario, the Ontario Waste Management Corporation[1] established a minimum depth of 10 metres of impervious clay as a criteria. This is probably an extreme case because the site will be used to contain only the most hazardous types of industrial waste unacceptable elsewhere. Even with this depth of clay, a back up leachate collection system with monitoring wells will be designed into the system.

6.5.3 Design and Operation Considerations

Most landfill sites are below ground requiring cover material, an impervious seal against surface water migration into the waste, followed by levelling and revegetation of the area when the site is full. Monitoring wells around the perimeter are needed to ensure that contaminated leachate does not migrate into the surrounding ground water supplies. A well run operation will provide for daily covering of the compacted waste with up to 1 metre of soil. This prevents odours in the area and the presence of gulls whose droppings can cause disease in foraging cattle and thereby transmission to humans.

While an area offering natural containment is preferred, this is not always possible in real life. Clay permeabilities of up to 10^{-8} cm/sec are desirable according to P.K. Saint et al[2]. The landfill site may be equipped with an impervious liner such as concrete, asphalt, rubber, plastic or a combination of these. Compatability of the waste with the liner material over a long period of time is essential.[6] An EPS report[3] describes sites using liners. Extra insurance can be obtained by lining the fill area with limestone to increase the pH of the leachate thereby inhibiting the migration of soluble metal compounds.

Landfill sites may be partially below and above ground or all above ground. Sometimes such sites become recreational areas for parks, ski slopes, etc. The same basic requirements apply to these sites. They must be engineered in such a way that leachate is minimized, monitored and treated if necessary. An impervious cover or cap is required to prevent migration of rainfall into the waste. The earth covering should be deep enough to support vegetation.

6.5.4 Future of Landfill Operations

Landfill sites will be in operation for some time in the future but less dependence will be placed upon them. The present situation is one of quiet tolerance by governmental authorities in the face of a situation which will take time to correct. In Ontario there are six sites accepting liquid industrial wastes. This will likely continue until at least 1990 when a central facility can be built in the Lincoln-Welland area. As central facilities come into operation, pressure will be put on the generators of such waste to use these much more expensive disposal plants. This has happened already in Quebec where Stablex has located a plant designed for inorganic wastes at Blainville. Refiners can expect to pay 10 to 30 times the present cost of landfilling ($16.30/ton in 1980).[4] Even though incineration and chemical fixation will be used by these sophisticated disposal plants in the future, the residues produced by these processes will require landfilling.

6.5.5 Wastes Amenable to Landfilling

Landfilling is such a versatile method of disposal that a good approach might be to list materials which should not be disposed of this way. These would include:

- Acid wastes
- Cyanides
- Halogenated organic compounds
- Materials containing PCB's, above 50 ppm
- Non-containerized liquid wastes

In general, the environmental engineer when considering landfill, either on-site or off-site, should be thoroughly aware of the degree of containment which an individual landfill site provides. If there is a risk of contaminating the leachate and surrounding groundwater, some other type of disposal should be considered. In the U.S.A., plants using dump sites have been held financially accountable by the courts for cleaning-up the whole site when the groundwater became contaminated.

We can expect future restrictions on landfilling of certain wastes in Canada as viable alternatives become available. At this point many practices are simply being tolerated by regulatory authorities.

REFERENCES

1. Ontario Waste Management Corporation "Interim Report on Priority of Study of Zones 1 and 2 Lands Golden Horseshoe - Geological Considerations", April 1983 by Gartner Lee Associates Ltd., p.14.
2. Saint, P.K. et al. "Effect of Landfill Disposal of Chemical Wastes on Groundwater Quality", presented at Geological Society of America, Minneapolis, Minnesota, 1972.
3. EPA "Liners for Sanitary Landfills and Chemical and Hazardous Waste Sites", by Ware, S.A and G.S. Jackson, EPA-600/9-78-005. EPA Cincinnati, Ohio, May 1978.
4. PACE Report No. 80-4 "Canadian Petroleum Refinery Industry Waste Survey", October 1980.
5. Chemical Engineering Journal September 1985 "Chemical Engineers Speak Out on Hazardous Waste Management."
6. Civic Public Works "Landfill Liners, Clay or Rubber. How Effective are They?", April 1985.

6.6 LEADED GASOLINE SLUDGE DISPOSAL

6.6.1 General

Over a period of years, leaded gasoline tanks accumulate liquids and solids in the bottom. If the tank is to be entered for repairs or serviced internally, these wastes must be removed.

6.6.2 Background

Finished gasoline is composed of several base stocks and a number of additives, such as tetraethyl lead, manganese compounds, gum inhibitors, detergents, anti-icing compounds, dyes, etc. During the blending process it is possible for liquids in the bottom of the component tanks to be carried over into the finished storage tank. This carryover may consist of water, caustic streams, Merox catalyst, and inhibitors containing derivatives of phenol and cresol injected into the rundown stream. The sludge will also contain some scale and rust from the inside of the storage tank.

6.6.3 Composition

API[1] reports the composition of leaded gasoline tank samples as follows:

	Average
Water	37.9%
Solids	59.0%
Oil	8.5%

Of the 27 samples tested, 26% failed the Leachate Extract Toxicity Test, 29% the Ignitability Test, 14% the Reactivity Test and none the Corrosivity Test. U.S. EPA has identified leaded tank bottoms as one of the 5 "listed" wastes from petroleum plants.

API[2] reports that the sludge consists of insoluble deposits wetted by water and hydrocarbons containing organic lead. The sludge will contain 0.04 Kg to 0.18 Kg (0.1 to 0.4 lbs) of organic lead per ton of sludge.

In 1980, PACE[3] reported that 17 refineries produced 35315 Kg (77834 lbs) of leaded sludge requiring disposal.

6.6.4 Potential Hazards

There are two major hazards connected with removing lead sludges from a storage tank. The air in the tank will contain organic lead requiring air supplied protective respiratory equipment, meeting government requirements, to be worn by all employees entering the tank. In addition to this, special protective clothing including socks, underwear, gloves, boots, impervious to gasoline, etc. must be provided, with spares as well. Strict personal hygiene is required with shower facilities available following the day's work, plus the washing of hands before eating or smoking. The supervisor of the work site must not only be fully aware of the hazards beforehand, he must make certain that his written procedures are enforced to the limit. All plants should have clear-cut written procedures for tank entry and cleaning. The API[4] have an excellent publication on the "Cleaning of Petroleum Storage Tanks" outlining safety recommendations which should be followed.

It should be noted that this section is not intended to be a definitive instruction on how to clean leaded storage tanks. References at the end of this section should be consulted for further details. The supervisor in charge and the plant environmental coordinator should work closely with the plant physician and provincial regulatory agencies before carrying out such work.

Leaded sludge removed from a tank must not be deposited carelessly within the tank compound. Under acidic soil conditions, the lead can be leached into the ground water.

To prevent employees from becoming contaminated, the disposal area should be adequately fenced and proper signs posted to prevent uncontrolled access.

6.6.5 Removal and Transportation

Since the volume of leaded sludge is generally small, hand tools such as shovels, brooms, scrapers, buckets, and rags are generally used for cleaning purposes. Care should be taken to ensure that all electrical equipment is explosion proof and suitable for a hydrocarbon atmosphere.

If the leaded sludge is to be disposed of by an outside contractor, a shipping manifest will be required.

All equipment used during the cleaning should be thoroughly washed and decontaminated before being stored.

6.6.6 Disposal Practices

The current study shows that 11% of leaded sludges are being weathered on land, 78% landfilled and the remaining 11% sent to an outside disposal contractor. In 1980, PACE[3] reported that 72.5% were spread on land and the remainder landfilled.

Where permitted by law, leaded sludge may be disposed of by weathering.[2] The sludge is spread to a depth of 8 cm (3 inches) or less on a relatively impervious surface such as concrete or clay and allowed to weather. If the temperature is above 0°C (32°F) this will take only four weeks, but a longer period is desirable.

REFERENCES

1. American Petroleum Institute "1982 Refinery Solid Wastes Survey" by Environmental Resources Management Inc., West Chester, Pennsylvania 19380.

2. American Petroleum Institute Publication 2015A "Guide for Controlling the Lead Hazard Associated with Tank Entry and Cleaning", June 1982.

3. PACE Report No. 80-4 "Canadian Petroleum Refining Industry Waste Survey", October 1980.

4. American Petroleum Institute Publication 2105 "Cleaning of Petroleum Storage Tanks."

6.7 INCINERATION

6.7.1 General

Incineration may be used to destroy organics or even to transform certain types of inorganics under controlled conditions. The by-products of incineration are gases and inert solids. The burning process may or may not require an extraneous fuel supply such as natural gas.

There are a number of different types of incinerators including, rotary kiln, fluidized multiple hearth bed, and direct burning. Rotary kilns are the most widely used.

6.7.2 Background

Incinerators were commonly used for the burning of municipal wastes during the 1950's and 1960's. The advent of air pollution regulations forced either closure of most of these plants or extensive modifications. As landfill sites become more distant and run into siting problems, incineration with energy recovery for municipalities is becoming an accepted practice. The improvements in combustion control and pollution control equipment are making incinerators more acceptable. Environment Canada is currently conducting a "National Incinerator and Testing and Evaluation Program" (NITEP)[1] at three typical energy from waste installations at Hamilton, Montreal and Parkdale (Prince Edward Island). The purpose of this testing program is to evaluate performance under various operating conditions.

Incineration is the ultimate in volume reduction[2]. Not only is volume reduced, but heavy metals are usually transformed into their oxides which are generally less toxic. Combustible carcinogenic materials, and biologically active compounds can be destroyed this way. Disposal of the ash usually presents no serious problem.

Incinerators however can present serious air pollution problems depending upon the composition of the original waste. Sulphur dioxide, sulphur trioxide, uncombusted hydrocarbons, hydrogen chloride, nitrogen oxides, heavy metals and particulates may be emitted from the stack. Often scrubber filters and electrostatic precipitators are required to remove or reduce the concentration of these contaminants to acceptable limits. Waste waters from scrubbers are usually acidic and contain dissolved and suspended solids as well.

As a result of these limitations and the high capital cost of incinerators, none of the Canadian petroleum plants employ incinerators for waste destruction. In the U.S.A., fluid bed and multiple hearth incinerators have been used with varying degrees of success.

6.7.3 Burner Type Incinerators

Steam or air is used to atomize the wastes which are burned in a refractory lined fire box. This can be either an open ended retort, a vertical cylindrical furnace or a rotary kiln. The design is simple, relatively low cost and favours small installations located close to the source. Liquid wastes with a high heat content, which can be rapidly atomized and combusted within the flow pattern, are suited to this type of incinerator. Residence times are rarely more than one second.

6.7.4 Fluid Bed Incinerators

These incinerators consist of a refractory lined cylindrical reactor containing a heated fluidized sand bed. An air blower keeps the sand bed suspended. The waste is injected into the fluidized sand bed where the temperature is between 900 and 1000°C (1600-1800°F). Thermal cracking and burning occur with light ends combustion in the area above the sand bed. Combustion air can be heated by the hot flue gases. A cyclone or wet scrubber is usually required to remove the sand carried over from the bed.

This type of incinerator generally handles all materials which can be injected into the bed by a progressive cavity pump or screw feeder.[2] The incinerator is relatively insensitive to changes in the heating value of the waste. Disadvantages are high capital cost and the amount of preheated air required. At reduced waste injection rates fuel utilization is poor.

6.7.5 Multiple Hearth Incinerators

This type of incinerator consists of a vertical cylindrical shell with a series of horizontal hearths placed one above the other. Waste is fed to the top of the shell and moved by rotating rabble arms to the centre of the hearth where it drops to the next level. In a standard six hearth model sludge is dried on the first and second hearths, burned on the next three and the ash cooled on the sixth. Preheated combustion air is distributed via a central shaft and cools the rabble arms. Advantages are high thermal efficiency and reduced auxiliary fuel needs. Disadvantages are thermal damage and corrosion to moving parts.

Wastes which are too soupy to form furrows, particles 2 cm (1 inch) or more in size and wastes which become sticky and form crusts when heated are not suitable feed. There are more than 100 installations in the U.S.A.[2] disposing of municipal sludges.

6.7.6 Rotary Kilns

Rotary kilns consist of a slightly inclined refractory lined rotating cylinder. The waste is fed via a belt or screw conveyor. Liquid wastes may be sprayed into the kiln through an atomizing nozzle. Auxiliary fuel burners in the afterburning section complete the combustion of soot and vapours liberated in the kiln. Rotation of the kiln agitates the waste thereby aiding the combustion process. Temperatures in the kiln are in the order of 800°C to 1400°C[2] (1400°F-2550°F).

An advantage of this type of incinerator is its ability to burn wastes with widely varying characteristics. Disadvantages include potential mechanical problems inherent in rotating the large kiln cylinder. Some problems have been experienced with wastes that ball up in the kiln or cake on the refractory creating combustion difficulties in the form of odours and smoke.

6.7.7 Wastes Suitable for Incineration

Incinerators in their various forms are capable of destroying a wide variety of waste materials. Frequently these incinerators require add-ons such as scrubbers, precipitators, bag house filters and sometimes reheat devices. No single technology can handle all wastes under all conditions.

Co-incineration can often be advantageous. This involves burning a hazardous waste with another waste having a significant heating value thereby reducing or eliminating auxiliary fuel requirements.

The current survey found the following materials from some petroleum plants are being incinerated off-site in Canada. These included sludges from gravity separators, bunker tanks, crude and gasoline (non-leaded) gasoline tanks, desalter sludges, spent phenolic caustic, spent clay, off specification sulphur, heat exchanger cleaning liquids, asphalt, laboratory waste liquids, furfural sludge and glycol/water mixtures.

In the U.S.A.[3] only 2-4% of the five listed wastes were incinerated in 1982. Of the ten non-listed wastes, 2% of the cooling tower sludge and 8% of the biosludge is incinerated. It is apparent that incineration does not enjoy very wide acceptance at present.

6.7.8 Future of Process

Centralized industrial waste disposal plants will normally have facilities to incinerate wastes which cannot be treated by physical/chemical methods. As provinces develop such facilities, we can expect to see an increased use of off-site incineration to dispose of a number of wastes now going elsewhere. At an average cost of \$250/tonne[3] (wet basis) we can expect some hesitation in using this technology.

REFERENCES

1. Environment Canada "National Incinerator Testing and Evaluation Program", Report EPS 3/UP/1, September 1985.

2. American Petroleum Institute "Manual on Disposal of Refinery Wastes" - Volume III.

3. American Petroleum Institute "1982 Refining Solid Waste Survey" by Environmental Resources Management Inc., West Chester, Pennsylvania 19380.

6.8 DEEP WELL DISPOSAL

6.8.1 General

Deep well injection of industrial wastes has been practiced in Canada since the 1950's. Deep well injection is based on the principle that certain kinds of liquids can be injected into sub-surface formations such as sands, sandstone, limestone, dolomite and fractured gneiss and will remain there indefinitely. These wells are usually 600 to 2,000 metres below grade and should not be confused with other underground disposal methods such as salt caverns.

Disposal wells have been used successfully in Alberta for the last 30 years. They are also used in the province of Saskatchewan for oil production and industrial wastes.

6.8.2 Required Conditions for a Disposal Well

There are a number of requirements which must be met before deep well disposal can be considered. Among these are:

- The formation has a good permeability to accept the waste and is large enough to accommodate the wastes.
- The receiving area is isolated from surface or potable groundwater or from oil and gas reservoirs.
- The area is geologically stable.

- The wastes may be pretreated so as to avoid plugging off the formation or reacting with it.
- The absence of known vertical fractures which could allow the waste to reach potable groundwater.

The federal government has established guidelines for the design and use of deep well disposal. In the province of Alberta the Energy Resource Conservation Board (AERCB) currently has responsibility for the construction and operation of deep wells while Alberta Environment is responsible for environmental protection.

6.8.3 Design and Operation

Figure 8 shows a cross section of a typical modern deep well injection system. The injection tubing rarely exceeds 10 cm (4 inches) in diameter and extends down into the disposal formation. A larger outer casing extends into the formation and is cement grouted at the bottom. A packer is used to isolate the outer casing from the formation, thereby producing a sealed annular space between the injection tube and the outer casing. Some type of corrosion inhibiting fluid such as kerosene fills the annular space. A pressure monitor can detect a drop in annulus pressure indicating a possible leak in the system.

Wastes are generally filtered or settled by gravity to remove solids that might plug the disposal formation. In most cases it is necessary to provide a multi-stage high pressure pump to overcome the formation resistance at higher flow rates.

After a period of time it may be necessary to take the well out of service for acidizing and reactivation of the formation.

6.8.4 Application

A number of substances may be injected into deep wells. Table 5 lists various waste streams being injected successfully into deep wells in Alberta in 1985. Generally speaking, any waste stream compatible with the disposal formation is a candidate. Sometimes dilution can make the liquid more acceptable.

At this time there is some uncertainty as to the materials which Alberta and Saskatchewan regulatory agencies will approve for this type of disposal. It is therefore advisable to establish early dialogue with the appropriate regulatory bodies on underground injection of hazardous waste, prior to the design, operation or use of such facilities.

FIGURE 8 - TYPICAL DEEP WELL DISPOSAL SYSTEM

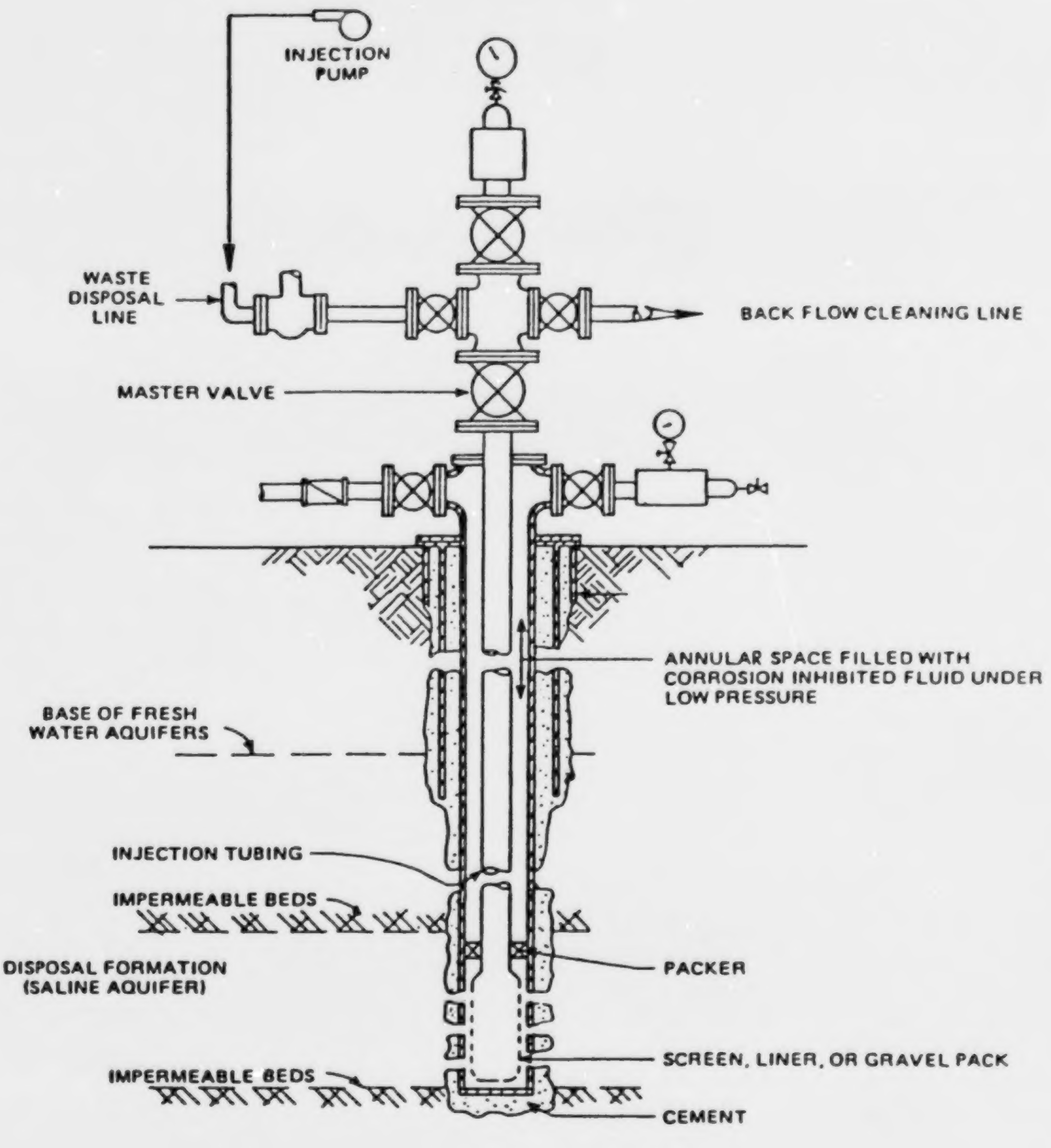

INJECTION PUMP
WASTE DISPOSAL LINE
BACK FLOW CLEANING LINE
MASTER VALVE
ANNULAR SPACE FILLED WITH CORROSION INHIBITED FLUID UNDER LOW PRESSURE
BASE OF FRESH WATER AQUIFERS
INJECTION TUBING
IMPERMEABLE BEDS
DISPOSAL FORMATION (SALINE AQUIFER)
PACKER
SCREEN, LINER, OR GRAVEL PACK
IMPERMEABLE BEDS
CEMENT

TABLE 5

WASTES CURRENTLY (1985) INJECTED INTO DEEP WELLS IN WESTERN CANADA

- Spent sulphidic caustics

- Spent phenolic caustics

- Merox catalyst (in caustic)

- Desalter brines

- Neutralized HF acid

- Heat exchanger cleaning liquids (inorganic)

- Laboratory liquid wastes (inorganic)

- Sour condensates

6.8.5 Potential Hazards

Since there is no control after a liquid is injected into a disposal formation, a thorough study should be done well in advance of any decision to use this alternative to surface treatment. Disposal wells have been a source of problems, e.g. in a mountainous region near Denver, Colorado. There have also been some problems along the St. Clair River in Ontario, but strictly speaking deep well disposal was not being practiced. In addition, wells abandoned during the 19th century were often improperly sealed after use, allowing vertical movement of brine or injected wastes into the groundwater.

Care must also be taken to carefully monitor the pressure in the annulus. A drop in pressure can signal that there is leakage or that corrosion problems are occurring. If corrosive wastes are to be injected, selection of the proper metallurgy or lining for the injection tubing is essential to ensure a long life for the system.

REFERENCES

1. Ontario Waste Management Corporation "Generic Process Technologies Studies" by Proctor Redfern Group, 1982.

2. Coffee, W.A., Attorvaley, A.S., Funk, R.J., and Sweet, R.G., "Deep Well Injection of Industrial Wastes", paper at 35th Industrial Waste Conference". Purdue University, Lafayette, Indiana, 1980.

3. Environment Council of Alberta "Report and Recommendations on Hazardous Waste Management in Alberta".

4. Canadian Petroleum Association "Environmental Operating Guidelines for the Alberta Petroleum Industry."

6.9 CHEMICAL FIXATION

6.9.1 General

Wastes may be solidified or chemically fixed following neutralization, detoxification or some other physical/chemical process aimed at volume reduction. The remaining sludges, precipitates or solids may be candidates for this process which results in a solid block of treated waste with structural integrity.

A number of processes and terms are used for this approach ([1]) such as solidification, stabilization, fixation and encapsulation. The latter process may or may not produce a solid core. While all of these processes differ in detail, their goal is the same, namely production of a solid suitable for landfill. In doing this, the risk of contaminating the leachate is virtually eliminated.

6.9.2 Process Description

Wastes are collected and segregated according to their compatability with each other during the physical treatment process. They are then placed or pumped into a treatment tank where various chemicals are added to cause precipitation, neutralization or detoxification. Sometimes another waste can be used, for example spent caustic, to neutralize an acid waste. The aqueous phase is decanted and either stored as make up for future physical/chemical treatment or biologically treated.

The next step involves contacting the sludge with the chemicals which can bring about solidification. The following materials are in commercial use:

- Cement based materials such as Portland Cement
- Pozzolanic materials (mixtures of fly ash, blast furnace slag and cement kiln dust) mixed with lime.
- Thermoplastic materials such as bitumen, paraffin and polyethylene.
- Organic polymers such as urea-formaldehyde.
- Glassification - use of glass-like materials.

Regardless of which process, the goal is the same, namely production of a solid. If cement based materials are used, the material may be mixed in a cement mixer en route to the landfill site. This process results in roughly a twofold volume increase over the original waste.

The last step involves pouring the cement/waste mixture into moulds within the landfill cell. When the cell is full, the site will be covered with an impermeable cap and the previous appearance restored.

The previous description describes a centralized toxic waste disposal plant located in Quebec. In some cases no such plant may exist and it may be necessary to carry out the solidification process on-site. There are a number of companies which can offer such a service.

6.9.3 Wastes Amenable to Chemical Fixation

Wastes with greater than 10-20% of organic components are not generally amenable to this type of treatment. The organics interfere with the chemical process of binding the waste materials together. ([2])

The presence of certain inorganic compounds can be harmful to the setting and curing of wastes treated by the cement process. Soluble salts of manganese, tin, zinc, copper and lead may interfere with the setting time and concrete strength. Samples of the waste material should be analyzed in advance by the waste facility laboratory and the producer will be advised as to their compatability with this process.

The pozzolanic process can handle moderate levels of organic wastes and shows more tolerance for certain heavy metals than cement based processes.

The other processes are not in wide use and will not be discussed further.

6.9.4 Future of Process

The chemical fixation process is ideally suited to the treatment of highly toxic wastes which cannot be treated economically and safely in any other way. It is significant that centralized industrial waste treatment plants now in operation or being planned depend on this process. If it is premised that a waste should be disposed of into the least sensitive media, then chemical fixation would meet this criteria.

As centralized facilities, either privately or government owned, become available in most provinces, we can expect to see many wastes now disposed of in other ways sent to these plants usually combined with incineration.

Experience indicates[3] that properly formulated solidification systems will produce a solidified mass which will change in the landfill essentially on the same time scale as natural rocks and minerals.

REFERENCES

1. Pojasck, R.B., "Toxic and Hazardous Waste Disposal - Processes for Stabilization/Solidification", Ann Arbor Publishers, 1979.

2. Ontario Waste Management Corporation "Generic Process Technologies Studies" by the Proctor Redfern Group, 1982.

3. Ontario Waste Management Corporation "Facility Design" by Monenco, 1985.

6.10 DISPOSAL OF HEAVY OIL WASTES FOR ROAD CONSTRUCTION

6.10.1 General

Heavy oils from upgraders can present difficult disposal problems. Due to their high molecular weight and other characteristics land treatment can be very slow and difficult. In addition, upgraders are normally located in areas where the summer is short and soil conditions may not be ideal.

The AERCB (Alberta Energy Resources Conservation Board) and Saskatchewan Energy and Mines presently approve but have reservations about the repeated disposal of oily wastes by application to road way surfaces and believes this is not a long term solution to the problem.

6.10.2 Background

The AERCB issued an Information Letter on November 14, 1985 to deal with the storage, handling and disposal of oily wastes. The letter emphasized the need to reduce to a minimum the volume of such wastes being produced by oil sands operators. It does recognize the fact that a guideline for disposal of such wastes is needed.

Certain requirements must be met before an approval from the AERCB will be granted for any road use. These requirements include the following:

1. The waste must not contain significant amounts of free salt water, fracturing acids or non-hydrocarbon contaminants, halogenated hydrocarbons or other manufactured oils.

2. The oil in the waste must have a relatively high density.

3. An analysis for free water content and chlorides is required.

4. Hazardous chemicals and the volumes used during heavy oil production must be identified.
5. An estimated total volume to be disposed of and location of disposal must be identified.

6.10.3 Dust Suppression

Once the foregoing data has been supplied and approval given by the AERCB, written consent from the local municipality is required. The local municipality is responsible for enforcement and control of the procedures used. An application rate of $12m^3$ per kilometre per centimetre of loose aggregate is recommended. This application rate should never exceed $40m^3$/Km. Weather conditions must be favourable.

6.10.4 Municipal Road Surfacing

Oily sand or other oily waste solids may be used for municipal road surfacing in limited situations when conducted in a careful and deliberate fashion. Solids that have been treated to reduce fluid or water content have more potential than raw oily solids. Approval from the AERCB involves meeting the requirements outlined previously, plus written consent from the local authorities.

6.10.5 Lease Roads

Disposal of oily wastes onto lease roads will not be allowed normally due to site rehabilitation concerns. However, some exceptions may be made for remote or inaccessible areas.

6.10.6 Private Driveways - Parking Areas

In Alberta, disposal of oily wastes on private driveways or parking areas is not allowed.

REFERENCES

1. Alberta Energy Resources Conservation Board Informational Letter, IL 85-16, November 14, 1985.

6.11 CO-DISPOSAL

6.11.1 General

Co-disposal refers to the mixing of waste streams or materials in such a way as to produce a waste usually less hazardous than either of the individual waste streams. On the other hand, it is sometimes advantageous to mix wastes in order to reduce the cost of transport or to make disposal easier.

6.11.2 Background

As a general rule petroleum plants tend toward waste segregation on the basis that mixtures are more difficult to treat or dispose of. This is generally true, however there are situations where co-disposal can be cost effective and therefore should be considered. A few exceptions are listed below:

Spent Caustics:
It is often advantageous to mix sulphidic with phenolic spent caustic and ship them together to an off-site plant, either for disposal or for re-use for their acid oil content. The caustics may be stored separately and then blended together in order to achieve an economic acid oil content or there may be a single storage tank for this purpose.

Merox Solution:
Spent Merox solution may be co-disposed with spent caustic.

Distillate Tank Bottoms:
Sludges from these tanks may be high in PNA's. Fly ash may be used to fixate the sludge before disposal to landfill

Cooling Tower Sludges:
As a matter of convenience cooling tower sludge may be co-disposed of with either sludges from surface run-off or with lime sludge from the boiler feed water system. The latter provides a high pH media limiting the mobility of heavy metals.

PART C

APPENDICES

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APPENDIX 1

GLOSSARY OF TERMS

APPENDIX 1

GLOSSARY OF TERMS

AIPG: American Institute of Professional Geologists

ALBERTA WASTE MATERIALS EXCHANGE: A clearning house that fosters the reuse, recycle and recovery of waste materials. Provides a bulletin listing available wastes and generators. Location: Edmonton, Alberta.

API: American Petroleum Institute

ASTM: American Society for Testing Materials

ASWMC: Alberta Special Waste Managment Corporation

AWWA: American Water Works Association

BITUMEN: Extremely viscous (tar-like) form of oil (when extracted from oil sands and upgraded it becomes a form of synthetic oil).

BUNKER: A heavy fuel oil used as a marine or industrial fuel.

CANADIAN WASTE MATERIALS EXCHANGE: A clearing house that promotes the reuse, recycle and recovery of waste materials. Publishes a periodic bulletin containing availability of wastes from specific generators. Location: Sheridan Park, Ontario.

CANUTEC: Canadian Transport Emergency Centre of the Federal Department of Transport

CARCINOGEN: A substance capable of causing cancer in living tissue.

CARRIER: A person accepting for transportation or transporting hazardous wastes for storage, treatment or disposal.

CATALYST: A substance which affects, provokes or accelerates chemical reactions without undergoing change itself.

CATION EXCHANGE CAPACITY (CEC): The sum of exchangeable cations a soil can absorb expressed in milli-equivalents per 100 grams of soil. It is a measure of a soil's ability to absorb undesirable ions in exchange for innocuous ions.

CO-DISPOSAL: A mixing of two or more wastes, where such a waste combination has environmental advantages (less hazardous) over the disposal of the waste stream by itself.

COKE: Carbon and impurities in the form of a black powder which results from the heating of bitumen at 500° Celsius.

COMPOSTING: A process utilizing bacteria and fungi to break down organic materials under controlled conditions into stable humus-like product.

CONVENTIONAL CRUDE OIL: Oil produced through wells by ordinary oil field methods.

CRADLE TO GRAVE: Handling of hazardous waste from the time of creation of the waste to its ultimate disposal.

CRUDE OIL: A material occurring naturally in the earth predominantly composed of mixtures of chemical compounds made up of carbon and hydrogen with possible traces of sulphur, oxygen, nitrogen, and inorganic salts.

CSA: Canadian Standards Association

CTC: Canadian Transport Commission

CWE: Canadian Waste Exchange

DEEP WELL INJECTION: A disposal method used under favourable geological conditions to pump pretreated liquid waste into porous geological strata that is isolated from fresh water aquifers.

DOWNSTREAM (PETROLEUM INDUSTRY SECTOR): Portion of the oil industry that manufactures, distributes and markets refined oil products.

EPA: United Stated Environmental Protection Agency

ESP: Electro-static precipitator for flue gas dust recovery

FCCU: Fluid Catalytic Cracking Unit

FIXATION (CHEMICAL) OF WASTE: A process by which a material is bounded or "fixed" into a relatively inert material like a concrete so that leachate from this material is non-toxic.

FOUR R'S: An approach to waste management based on the following four ways of minimizing waste prior to disposal; (a) Reduction, (b) Reuse, (c) Recycling, (d) Recovery.

GENERATOR: A person consigning hazardous waste for storage, treatment or disposal.

GEOLOGY: The science of the earth, its forces, rocks, groundwater, and hazards.

GROUNDWATER: Water existing in the soil and rocks, below the land surface (surface water refers to lakes, streams, rivers).

HAZARD: A physical situation with a potential for human injury, damage to property, damage to the environment or a combination of these.

HAZARDOUS WASTE: A waste that due to its nature and quantity is potentially hazardous to human health and the environment and which requires special disposal techniques.

HEAVY FUEL OIL: The residue of crude oil refining processes which remains after the lighter products such as gasolines, diesel and home heating oil have been distilled from the crude oil.

HEAVY OIL: Crude oil which is more viscous, or thicker, than normal crudes and therefore does not flow as freely.

HYDROCARBONS: Organic chemical compounds of hydrogen and carbon atoms which form the basis of all petroleum products. May exist as gases, liquids or solids.

INCINERATOR: A fired heater using controlled combustion for burning waste in order to reduce its volume. Examples of waste incinerator types include rotary kiln, fluidized bed, and multiple hearth.

INDUSTRIAL WASTE INCINERATOR: A special incinerator designed to burn particular types of waste, e.g. chlorinated organic materials. These incinerators are made not only for thermal decomposition of the waste but also for treating the exit flue gases to prevent air pollution.

LANDFARMING: See Land Treatment.

LANDFILL: Burial of waste in the ground.

LAND TREATMENT: Commonly called landfarming in the industry. Makes use of soil bacteria to break down organic waste into stable materials.

LC_{50} (Median lethal concentration): The concentration of a substance in the form of a vapour, dust or mist which when administered by continuous inhalation to test animals over a period of time causes death to 50% of the test population within a set time period (14 days).

LD_{50} (Median lethal dose): The amount of substance expressed in milligrams per kilogram of body weight which when administered to the skin (dermal) or orally to test animals over a period of time causes death to 50% of the test population within a set time period (14 days).

LEACHATE: When water percolates through a material it dissolves (leaches) the soluble compounds from the material. The resulting solution is leachate.

LINER: Plastic membrane and/or clay layer in a secure landfill, designed to prevent the entry of groundwater and the exit of liquid leachate.

MANIFEST: A shipping document, required by the Transportation of Dangerous Goods legislation for all hazardous waste shipments, naming the material, quantity, origin, route and destination.

MSDS: Material Safety Data Sheet

MUNICIPAL DUMP: See Sanitary Landfill.

NIMBY: "Not in My Back Yard." An acronym used to describe public aversion to siting waste treatment plants in their community.

NWWA: National Water Well Association

OPEN-PIT BURNING: Burning of waste materials in a partially excavated site.

OWMC: Ontario Waste Management Corporation

PACE: Petroleum Association for Conservation of the Canadian Environment

PCB'S (POLYCHLORINATED BIPHENYLS): Very stable fire-resistant organic fluids used in making plastics and as insulation in heavy-duty electrical equipment. PCB's do not readily biodegrade in the environment but bioaccumulate in animal tissue. No longer manufactured or sold in Canada, but still contained in older electrical equipment in petroleum plants.

PERCOLATE: Movement of water downward through soil and rock.

PNA: Polynuclear aromatic hydrocarbons - chemical compounds made up of condensed benzene rings, some of which are carcinogens.

RCRA: U.S. Resource Conservation and Recovery Act

RECEIVER: A person receiving hazardous waste for storage, treatment or disposal.

RECLAIMER: An off-site company that recovers materials from a waste for their monetary value, e.g. reclaiming platinum from a spent catalyst.

RECOVERY: Involves regeneration of a waste or recovery of materials contained in that waste for commercial use, e.g. extraction of cresols from spent phenolic caustics.

RECYCLE: An activity or treatment that eliminates or reduces the volume of a waste by generating a feedstock for another process located on-site, e.g. slop oil to crude distillation unit.

REDUCTION: Lowering the quantity of waste generated at source by:
1) making a process or feedstock change
2) increasing system efficiency of process
3) modifying the product slate with the objective of decreasing the quantity of the waste material generated.

REFINERY: A complex of process units used for the separation and conversion of crude oil (conventional or synthetic) into petroleum products.

REUSE: A secondary use found for a normally discarded waste, e.g. fly ash from flue gases used in cement manufacture.

RISK: A measure of the potential threat from hazardous waste which depends on the nature of the hazard presented and the probability of its occurrence.

ROAD OILING: Use of oils or oil by-products for dust suppression on dirt roads.

SANITARY LANDFILL: A means of municipal waste disposal where waste is placed in the ground, compacted by repeated bulldozing and covered with earth to a specific thickness. It generally does not have a liner or leachate collection system.

SECURE LANDFILL: Burial of waste, generally in containers, at a geologically chosen site, protected by clay or plastic barriers to groundwater, with a leachate collection system, and a groundwater monitoring system.

SYNTHETIC CRUDE: A blend of hydrocarbons resulting from the thermal cracking and purifying of bitumen.

TAILINGS: A sludge-like mixture of sand, water and clay remaining after bitumen has been removed from the ore; usually stored in a diked-in pond.

TDGA: Federal Transportation of Dangerous Goods Act (1980)

TDGR: Transportation of Dangerous Goods Regulations

"TOWN" DUMP: Sanitary landfill used in small communities where waste may be exposed to open pit burning prior to burial.

TOXIC WASTE: A waste material capable of causing injury, illness or damage to humans, animals or other living organisms through oral ingestion, inhalation or absorption through any body surface.

UPGRADER: A plant designed to convert heavy oil into synthetic oil as a feedstock to a conventional refinery.

UPSTREAM (PETROLEUM INDUSTRY SECTOR): That segment of the oil industry that explores for, and produces, oil and natural gas.

WASTE: A material for which the owner or generator has no further use and discards.

WATER TABLE: Groundwater percolates downward until it saturates all the pores in the soil and rock. The upper edge of this saturated zone is the water table.

WDS: Waste Data Sheet

APPENDIX 2

SUMMARY OF LEGISLATION

APPENDIX 2

SUMMARY OF LEGISLATION

INTRODUCTION

This Appendix summarizes the federal and provincial legislation relative to the handling, storage, treatment and disposal of petroleum plant wastes. No attempt has been made to include all of the environmental statutes or to explain in any detail the ramifications of those discussed.

For further details on specific legislation, the reader is referred to page C-12 where a comprehensive list of acts and regulations is shown. These may be obtained from the appropriate government agency.

The underlying principles of waste management legislation throughout Canada are fundamentally based on "cradle to grave" controls of hazardous materials. All jurisdictions have adopted the "Four R's" as a logical baseline for waste management and are strong advocates of inter-industry waste exchange programs. Waste regulations under the various Federal and Provincial Acts are being motivated by public concern over long term effects of contaminated soil and groundwater and also over victim compensation and large scale clean-up costs.

Except for crown corporations, such as Petro-Canada, the federal government exercises only an indirect control over those wastes produced by refineries and upgraders. Direct control is normally vested in the provinces. Municipal governments are involved as operators of sanitary landfills.

FEDERAL GOVERNMENT

POLICY

Environment Canada's operating policy is based on the assumption that waste management is primarily a provincial jurisdiction. Environment Canada's role is limited, therefore, to international and interprovincial movement of hazardous waste under the legislative authority of the Transportation of Dangerous Goods Act and the Ocean Dumping Control Act.

The federal government also plays a supportive role to the provinces by conducting research, investigating toxic substances and generally trying to bring about some degree of uniformity among the provinces in their classification, transportation and administrative procedures. The federal government however, can and does, ban or regulate the use of toxic materials of a highly pervasive nature where the health and welfare of the public at large may be threatened.

LEGISLATION

ENVIRONMENTAL CONTAMINANTS ACT and its regulations prohibit the release of designated substances into the environment. Polychlorinated biphenyls (PCB's), chlorophenols, dichloranes, mercury, Mirex and halogenated substances have been designated. The use of such substances must be reported to Environment Canada and a record of all amounts employed must be kept. The use of PCB's is limited to existing transformers and capacitors and strict control over the disposition of existing sources is imposed. From time to time a list of candidate and priority chemicals is issued. These are substances under investigation and may require regulatory control when more is known about their toxicity.

TRANSPORTATION OF DANGEROUS GOODS ACT lists a Schedule of Hazardous Goods considered dangerous to health, property or the environment. The Act prescribes standards for the safe transportation of dangerous goods by road, air or water. A common waybill of manifest document for wastes crossing provincial boundaries, a "cradle to grave" tracking system and compatibility with U.S.A. regulations are some of the main aims. Provinces are expected to enact complementary legislation.

FISHERIES ACT regulates liquid effluent emissions from petroleum plants and could be used to regulate discharges from waste sites that impact on fisheries.

Oil pollution prevention regulations made under the Fisheries Act set out provisions for the design and equipment requirements for ships in order to prevent spills. These include cargo, fuel and ballast handling equipment, emergency procedures and record keeping.

BRITISH COLUMBIA

POLICY

The general policy of government is to leave the design and operation of hazardous waste treatment and disposal facilities to the private sector.

LEGISLATION

WASTE MANAGEMENT ACT and its regulations empowers the Ministry of the Environment to participate in waste management planning at the municipal level. It also provides the Ministry with the authority to deal with special wastes, spill prevention and response, a waste manifest and tracking system, and control of classification, handling and transportation of wastes.

PESTICIDES CONTROL ACT governs the use, transportation, storage and disposal of pesticides.

HEALTH ACT plays a diminishing role in waste management.

ALBERTA

POLICY

Responsibility for dealing with industrial and hazardous waste is centralized in the Department of the Environment's Waste Management Branch. Regulations introduced in 1985 provide for a comprehensive waste management system including waste classification, registration of waste generators, haulers and disposal facility operators.

The government, at present, believes that the private sector is best able to build and operate a plant for the disposal of special wastes. The province established the Alberta Special Waste Management Corporation (ASWMC) as a crown corporation with responsibility for coordinating a special waste management system using the private sector to design and operate the facility. Following a successful local plebiscite a disposal plant will be built in the Swan Hills area.

The disposal of solid waste falls under municipal control.

LEGISLATION

HAZARDOUS CHEMICAL ACT and its regulations establish a classification system for wastes, and control their storage, handling and disposal. A manifest system is used for tracking the wastes. As much as possible, the province will follow the approach laid down by the Transportation of Dangerous Goods Regulations by the federal government. The Act is administered by Alberta Environment. Hazardous waste regulations are currently (1986) under extensive review.

OIL AND GAS CONSERVATION ACT controls wastes from oil and gas fields as well as pipelines and is administered by the Alberta Energy Resources Conservation Board (AERCB).

TRANSPORTATION OF DANGEROUS GOODS ACT is administered through five regional offices with seven inspectors to check on any facility or vehicle into which dangerous goods are loaded, unloaded or transported.

SASKATCHEWAN

POLICY

Saskatchewan Environment believes it can best learn from the experience and mistakes of others and has therefore delayed the issuance of hazardous waste regulations. New industries are expected to install best available technology while existing industries require best practical technology for industrial wastes. Monitoring programs are a requirement.

LEGISLATION

ENVIRONMENTAL PROTECTION AND MANAGEMENT ACT (1983-1984) lacks regulations at present but as of late 1985 these were being drafted. The regulations will control the classification, transportation, storage, processing, disposal, re-use and recycling of hazardous wastes. There are currently no licensed facilities for treatment and disposal of hazardous wastes in Saskatchewan. Municipal waste management, formerly under the Health Department, has been transferred to the Environment Department. There are Waste Management Regulations under the Public Health Act for solid waste disposal.

PEST CONTROL PRODUCTS ACT and regulations control the use and application of all pesticides.

TRANSPORTATION OF DANGEROUS GOODS ACT when passed will come under the Department of Highways and Transportation and will likely parallel the federal TDG Act.

ONTARIO

POLICY

All aspects of waste control in the province have been centralized within the Ministry of the Environment (MOE) and its Certificate of Approval system. The Waste Management Branch of the MOE is responsible for a comprehensive industrial waste management system which includes:

- mandatory registration of liquid industrial and hazardous wastes
- standards for waste carriers and their certification
- manifest system for tracking waste

Under the 1985 amendments to the regulations, all producers of liquid industrial wastes and hazardous wastes must register their companies and the waste with the Ministry by September 17, 1986.

The Ontario Waste Management Corporation was established to locate a site for an industrial waste disposal plant and then to design and operate the resulting facility. A site in the Lincoln-Welland area has been selected as the preferred site but it must undergo the environmental assessment process involving a public hearing, before it receives Cabinet approval.

LEGISLATION

ENVIRONMENTAL PROTECTION ACT under Part V (Waste Management) governs the issuance of Certificates of Approval for the operation of all existing and proposed or expanded sites. A public hearing will probably be needed before approval is given in sensitive cases. A Ministerial Order can require that an operator of a facility take such remedial action as the government deems necessary. The Order has the full force of law. This might include removal of on-site leachate if there is the possibility of future migration beyond the owner's property. A waybill system is used to trace the movement of certain substances.

DANGEROUS GOODS TRANSPORTATION ACT parallels to a large degree the federal TDG Act.

PESTICIDES ACT and its regulations control the handling, storage, use, disposal and transportation of pesticides including the licensing of exterminators.

QUEBEC

POLICY

Quebec's policy on hazardous waste is based on a comprehensive waste management regime including waste disposal and transport. The province views its role as one of standard setting while the treatment and disposal of industrial waste is left to industry and private enterprise.

Plants for the treatment and disposal of industrial wastes have been left in the hands of the private sector. There are two such plants; one for the incineration of liquid organic wastes run by Tricil at Ville Mercier, and the second run by Stablex Corporation at Blainville, Quebec for inorganic sludges and solids.

LEGISLATION

ENVIRONMENTAL QUALITY ACT and a set of Hazardous Waste Regulations issued in October 1985 spell out permit requirements and all other aspects of hazardous control including a definition of acceptable leachate quality.

NOVA SCOTIA

POLICY

As a policy, Nova Scotia is developing a hazardous waste data base through a waste manifest system prior to developing a comprehensive control program. At present, waste management is controlled largely through the permit system working cooperatively with industry in existing situations. No regulations will be put in place until a manifest system is implemented.

LEGISLATION

ENVIRONMENTAL PROTECTION ACT prevails over all other Acts including municipal by-laws. The Act sets forth a procedure for obtaining permits, imposes standards of compliance and generally parallels similar legislation in other provinces. To date there are no regulations.

DANGEROUS GOODS TRANSPORTATION ACT was passed in 1982 and regulations modelled after the federal TDG Regulations were adopted in 1985.

WASTE MANAGEMENT LEGISLATION

FEDERAL

- Transportation of Dangerous Goods Act (1980)
- Transportation of Dangerous Goods Regulations (S.O.R./85-77)
- Ocean Dumping Control Act (S.C. 1980-81-82-83)
- Fisheries Act (R.S.C. 1970, C.V.-14 as amended)
- Environmental Contaminants Act (S.C. 1974-75-76, C.72 as amended
- Canada Shipping Act (R.S.C. 1970, C.S-9 as amended)

BRITISH COLUMBIA

- Waste Management Act (S.B.C. 1982, C.41 as amended)
- Waste Management Regulations (B.C. 432/82 as amended)
- Health Act (R.S.B.C. 1979, C.161 as amended)
- Transport of Dangerous Goods Act (S.B.C. 1985, C.17)
- Transport of Dangerous Goods Regulation (B.C. Reg.203/85)

ALBERTA

- Energy Resource Conservation Act (R.S.A. 1980)
- Hazardous Chemicals Act (R.S.A. 1980, C.H-3 as amended)
- Hazardous Waste Regulation (A.Reg. 49/85)
- Special Waste Management Corporation Act (R.S.A. 1982, C.S-21.5 as amended)
- Transportation of Dangerous Goods Control Act (R.S.A. 1982)
- Transportation of Dangerous Goods Regulation (A. Reg.383/85)
- Waste Management Regulation (A.Reg. 250/85 pursuant to Public Health Act

SASKATCHEWAN

- Environmental Management and Protection Act (S.S. 1983-84)
- Department of Environment Act (S.S. 1983-84)
- Public Health Act (R.S.S. 1978, C.P.-37 as amended)
- Waste Management Regulations (S. Reg. 198-72 as amended)
- Dangerous Goods Transportation Act (S.S. 1984-85 as amended)
- PCB Transporation Regulations (S. Reg. 521/85) pursuant to Vehicles Act

ONTARIO

- Environmental Protection Act (R.S.O. 1980, C.141 as amended)
- Waste Management - General Regulation (O. Reg. 309 as amended)
- Waste Management - PCB Regulation (O. Reg. 11/82 as amended)
- Spills Regulation (O. Reg. 618/85)
- Dangerous Goods Transportation Act (S.O. 1981, C.69)
- Dangerous Goods Transportation General Regulation (O. Reg. 363/85)

QUEBEC

- Environmental Quality Act (R.S.Q. 1977, C.Q.-2 as amended)
- Hazardous Waste Regulation (O.C. 1000-85)
- Regulation Respecting Solid Waste (R.R.Q. 1981, C.Q-2 as amended)
- Regulation Respecting Transport of Waste (R.R.Q. 1981)
- Highway Safety Code (R.S.Q., C-241)

NOVA SCOTIA

- Environment Protection Act (S.N.S. 1973, C.6 as amended)
- Dangerous Goods Transportation Act (S.N.S. 1982)
- General Regulations (N.S. Reg. 152/85) pursuant to Dangerous Goods Transportation Act.

APPENDIX 3

TESTING AND MONITORING PROTOCOLS

APPENDIX 3

TESTING AND MONITORING PROTOCOLS

INTRODUCTION

To date, no single definition of hazardous waste is acceptable to all Canadian provinces, the federal government and other countries. Each of the various jurisdictions have developed their own approach and while there is some degree of uniformity there is also disagreement. As a rule, the regulatory agencies' approach to defining hazardous waste is to; (a) specify a list of hazardous wastes (along with exemptions) and (b) to apply a set of criteria based on specific test protocols (standard test methods and procedures). The onus of determining whether a waste is hazardous or not lies with the waste generator.

In Ontario, Regulation 309 currently defines a hazardous waste as "waste that requires special precautions in its storage, collection, transportation, treatment or disposal to prevent damage to persons or property and includes explosive, flammable, volatile, radioactive, toxic and pathological waste but does not include asbestos waste."

Alberta defines a hazardous chemical under the Hazardous Chemicals Act amended in 1982 as "any substance, class of substances or mixture of substances that is entering or is capable of entering the environment in a quantity or concentration or under conditions that may constitute a danger to (i) the environment, (ii) plant or animal life, or (iii) human health.

Some problems have been encountered in interpreting the definitions in Regulation 309 in Ontario. Terms such as "special precautions", "flammable" and "toxic" are ambiguous and lack specific protocols or methodologies to define them. The result has been confusion among waste generators and the ability of certain waste disposal sites to handle specific wastes. The Ministry of the Environment released the "Interim Guideline for the Interpretation of the Hazardous Waste Definition" (Regulation 309). This instruction calls for testing whenever possible and listing of known hazardous chemicals to fill the gaps.

The test procedures in Ontario follow closely those established earlier by the U.S. Environmental Protection Agency (EPA), under the Resource Conservation and Recovery Act (RCRA). The standard EPA tests for determining reactivity, ignitability, corrosivity and toxicity have been adopted by Ontario. There are two major differences however. A pathological characteristic has been added to the definition. In addition a list of contaminants of major concern, namely specific isomers of dioxin and furans have been added. The responsibility for conducting the necessary laboratory analyses rests with the producer or generator or the waste.

According to the U.S. EPA regulations passed in 1980, a waste is hazardous if it is:

(i) not specifically excluded by the regulations,
(ii) specifically listed, or
(iii) not able to pass the tests for ignitability, corrosivity, reactivity and toxicity.

Wastes found to exhibit the characteristics shown under (iii) are automatically "listed". As a result, for petroleum plants, the following wastes are considered hazardous:

- API separator sludge (ignitable, toxic)
- D.A.F. float (ignitable, toxic)
- Slop oil emulsion solids (toxic)
- Leaded tank bottoms (toxic)
- Heat exchanger clean-out sludge (toxic, corrosive)

All shipments of wastes to the U.S. from Canada must comply with EPA requirements. This means the waste producer must first carry out laboratory analysis to determine if the waste is hazardous as determined by the criteria mentioned previously.

Since legal requirements are very site specific, the reader is advised to contact his local provincial agency to obtain the latest information on the testing protocols that must be applied to his case. However, for purposes of general understanding of the fundamental principles involved, a brief summary of the benchmark U.S. protocols is provided below.

The EPA test methods used to determine if a waste is hazardous are:

Ignitability

A waste is hazardous if:

1. It is a liquid other than an aqueous solution containing less than 24% alcohol by volume and has a Pensky-Martin Closed Cup flash test less than 60°C (140°F) ASTM Standard D93-79. The Setacup Closed Cup Tester specified in D3278-78 is an alternative procedure.

2. It is not a liquid and is capable under standard temperature and pressure of causing fire through friction, absorption of moisture, or spontaneous chemical changes and when ignited burns so vigorously and persistently that it creates a hazard.

3. It is an ignitable compressed gas.

4. It is an oxidizer.

Corrosivity

A waste is corrosive if:

1. It is aqueous and has a pH equal to 2 or less and greater than 12.5 as determined by EPA's "Methods for Analysis of Water and Wastes" EPA 600/4-79-020 1979.

2. It is a liquid and corrodes SAE 1020 steel at a rate greater than 6.35 mm (0.250 inches) per year at a test temperature of 55°C (130°F) as determined by National Association of Engineers' Standard TM-01-69.

Reactivity

A waste exhibits this characteristic if:

1. It is normally unstable and readily undergoes violent change without detonating.

2. It reacts violently with water.

3. It forms potentially explosive mixtures with water.

4. When mixed with water it generates toxic gases, vapours or fumes in a quantity sufficient to present a danger to human health or the environment.

5. It is a cyanide or sulphide bearing waste which when exposed to pH conditions between 2.0 and 12.5 can generate toxic gases, vapours or fumes in a quantity sufficient to present a danger to human health or the environment.

6. It is capable of detonation or explosive reaction if it is subjected to a strong initiating source or it if is heated under confinement.

7. It is readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure.

8. It is a forbidden explosive.

Toxicity

A waste is toxic if the test procedure outlined in the U.S. Federal Register or its equivalent is followed and the extract from a representative sample of the waste contains any of the contaminants listed in the regulation at a concentration equal to or greater than the limit specified.

The purpose of the leachate toxicity test is to indicate quantitatively the potential release of hazardous contaminants from a solid waste.

This test involves the production of an extract or leachate by mixing the solid waste and a solvent according to a complex procedure and separating the liquid phase from the mixture. Specific compounds in the leachate are then analyzed for and their concentrations compared to prescribed upper limit values. These limits are set at 100 times those specified in the U.S. Interim Drinking Water Standards (see Table 1).

The leaching conditions are specified to "simulate" co-disposal with municipal waste where acids result from refuse decomposition. The test conditions were set to represent a landfill containing 5% industrial waste under certain rainfall and landfill conditions.

There have been major criticisms of this test and it is expected that a revised test will be issued some time in 1987 aimed at improving the reproducibility and widening the scope of the test method.

Another way to determine toxicity is by means of the National Institute of Occupational Safety and Health (NIOSH) document issued in July 1984 entitled "Registry of Toxic Effects of Chemical Substances". The level of toxicity can be expressed in terms of LD_{50} or LC_{50} values using the most sensitive species provided in this document.

A list of current leachate quality criteria used in Ontario is provided in Table 1 and the leachate extraction procedure is included by way of example in Addendum 1.

MONITORING OF LAND TREATMENT OPERATIONS (LANDFARMS)

Once the site for a landfarm operation has been chosen, monitoring of the soil and groundwater will usually be required for regulatory purposes. Monitoring will help the operator to gauge the success of the land treatment operation.

Monitoring is carried out during three distinct phases of the landfarm's life span, namely, pre-operational, operational, and post-closure. Each of these phases will be discussed briefly.

Pre-Operational

Since the pre-operational phase reflects the background initial conditions it can be carried out only once and therefore must be done carefully and comprehensively. Sample points for soil testing must be selected carefully and recorded on a map or plot plan of the area for future use during the operational and post-closure phases. A single soil sample may be made up of 20 or more sub-samples, combined, and mixed together for accurate representation. If the soil is sandy, it is important to take sub-surface samples as well since sludges can easily migrate vertically in such soils.

TABLE 1

ONTARIO LEACHATE CRITERIA AND U.S. INTERIM DRINKING WATER STANDARDS

CONTAMINANT	CONCENTRATION LEVEL - mg/1	
	U.S EPA (^{1})	Ontario (^{2})
2,4,5-TP / Silvex / 2-(2,4,5-Trichlorophenoxy) propionic acid	0.01	0.01
2,4-D	0.1	0.1
Aldrin + Dieldrin	---	0.0007
Arsenic	2.2×10^{-6}*	0.05
Asbestos (Fibres/Ml)	300	1.0
Barium	---	1.0
Boron	---	5.0
Cadmium	0.010	0.005
Carbaryl / 1-Naphthyl-N-methyl carbamate /Sevin	---	0.07
Chlordane	4.6×10^{-6}*	0.007
Chromium - Cr^{3+}	0.170	---
Chromium - Cr^{6+}	0.050	---
Chromium - (total)	---	0.05
Cyanide (free)	0.2	0.2
DDT	0.24×10^{-6}*	0.03
Diazinon /Phospordithioic acid, 0,0-diethyl 0-(2-isopropyl-6-methyl-4-pyrimidinyl) ester	---	0.0002
Endrin	0.001	0.0002
Fluoride	000	2.4
Heptachlor + Heptachlor epoxide	2.78×10^{-6}*	0.003
Lead	0.05	0.05
Lindane	18.6×10^{-6}*	0.004
Mercury	14.4×10^{-6}*	0.001
Methyoxychlor / 1,1,1-Trichloro-2, 2-bis(p-methoxyphenyl) ethane	---	0.1
Methyl Parathion	0.10	0.007
Nitrate + Nitrite	---	10.0
Nitrilotriacetic Acid	---	0.05
Nitrite	---	1.0
PCBs	$.79 \times 10^{-6}$*	0.003
Parathion	0.10	0.035
Selenium	0.01	0.01
Silver	0.05	0.05
Toxaphene	7.1×10^{-6}*	0.005
Trihalomethanes	0.0019	0.35
Uranium	---	0.02

Note:

(1) U.S. Interim Drinking Water Standards (1980). Waste is considered toxic when concentration of the contaminant in leachate exceeds 100 times the interim standard.

(2) Values marked with asterisk (*) represent a 10^{-5} incremental cancer risk - recommended concentration is zero (U.S. EPA 1980).

(3) Ontario Regulation 309 (1985) leachate criteria. Waste is considered toxic when leachate contains contaminant in concentration exceeding 100 times the value of the criteria listed.

Groundwater sampling is done with piezometer wells located in such a way as to take advantage of the known direction of groundwater flow. At least one central well is needed for reference purposes. A hydrogeologist is generally engaged to install and interpret the results. If underdrains are installed in poorly drained soil, this water should also be analyzed.

Operational

This is similar to the pre-operational but need not be as comprehensive or as frequent unless troubles are being experienced.

Post-closure

This can be less comprehensive and less frequent. After a certain time it may be phased out entirely.

Analysis of sludges, soils and water follow established procedures and are described in the PACE Report No. 81-5A "Landspreading of Sludges at Petroleum Facilities." A suggested monitoring schedule extracted from this document is shown on Table 2.

TABLE 2

SUGGESTED LAND TREATMENT SITE MONITORING SCHEDULE

SAMPLE TYPE	PRE-MONITORING	APPROX. FREQUENCY	ONGOING MONITORING	APPROX. FREQUENCY	POST-CLOSURE MONITORING	APPROX. FREQUENCY
Soil:	Texture (a)	Once	pH (a,b)	1-2/mo.	pH (a,b)	1/1-3 yr.
a) Surface	pH (a,b)		Oil (a,b)	"	Oil (a,b)	
b) Subsurface	CEC (a)		(Organic-C) (a,b)	"	Metals (a,b)	
	EC (a,b)		Moisture (a,b)	"	Nitrate (a,b)	
	Oil (a,b)		Nutrients (a,b)	"	HC (a,b)	
	(Organic-C)(a)		Metals (a,b)	1-2/yr.	Phenols (a,b)	
	Moisture (a)		CEC (a,b)	"		
	Available-N(a)		HC (a,b)	"		
	Nutrients (a)		Phenols (a,b)	"		
	Metals (a,b)		(Microbes)	N.A.		
	HC (a,b)					
Groundwater	pH	Once	pH	1-2/yr.	pH	1/1-3 yr.
	Oil		Oil	"	Oil	
	Nitrate, etc.		Nitrate, etc.	"	Nitrate, etc.	
	Nutrients		Nutrients	"	Nutrients	
	Metals		Metals	"	Metals	
	Phenols		Phenols	"	Phenols	
	HC		HC		HC	
Sludge	pH		Oil	On application	Nil	
	Oil		Metals	"		
	(Organic-C)		Solids	"		
	Available-N		Moisture	"		
	Nutrients		Phenols	"		
	Metals		HC	"		
	Solids		Cyanides	"		
	Moisture			"		
	Phenols					
	HC					
	Cyanides					
	Dissolved solids					
	(Ash)					
	(Volatiles)					

APPENDIX 3 - Addendum 1

EXAMPLE OF LEACHATE EXTRACTION SYSTEM
(Based on Ontario Regulation 309 (1985))

(1) Sampling

Collect a sufficient amount of sample to provide approximately 100 g of solid material, using techniques which ensure that the sample is representative of the waste.

(2) Equipment

2.1 Sieve, 9.5 mm mesh opening, stainless steel or plastic material.

2.2 Stainless steel filtration unit, 142 mm diameter, minimum 1L capacity, capable of sustaining a pressure of 5 kg/cm^2, applied to the solution to be filtered.

2.3 Membrane filter, 142 mm diameter, 0.45 μm diameter pore size, made of synthetic organic material such as cellulose acetate, cellulose nitrate, nylon or polycarbonate and which is compatible with the leachate to be filtered. Teflon is recommended for organic constituents.

2.4 Glass fibre prefilter, 124 mm diameter, 3 μm to 12 μm pore size range.

2.5 Vacuum filtration unit, 90 mm diameter.

2.6 Membrane filter 90 mm diameter as per Step 2.3.

2.7 Glass fibre filter 70 mm diameter as per Step 2.4.

2.8 Solid waste rotary extractor - a device that rotates the bottles end over end about a central axis through 360 °, with a speed of 10 rpm. The dimensions of the box will depend on the needs of each laboratory. (Figure 1).

2.9 Structural Integrity Tester with a 3.18 cm diameter hammer weighing 0.33 kilogram and having a free fall of 15.24 cm. (Figure 2).

2.10 pH meter, with a readability of 0.01 pH unit and accuracy of ± 0.1 pH units.

2.11 Cylindrical bottles, wide mouth, 1250 mL capacity, polyethylene or glass with Teflon lined cap for inorganic constituents; glass with Teflon-lined cap or Teflon bottles for organic constituents.

2.12 Cleaning Procedure

All glassware and equipment that comes into contact with the sample should be cleaned in the following way before each use:

2.12.1 Wash with a non-phosphate detergent solution.

2.12.2 Rinse twice with tap water.

2.12.3 Rinse twice with reagent water.

2.12.4 Wash with 10% nitric acid.

2.12.5 Rinse several times with reagent water.

2.12.6 Store bottles filled with 10% nitric acid, until ready to use.

2.12.7 Rinse several times with reagent water before use.

2.12.8 Rinse clean oven dried bottles with methylene chloride, followed by methanol, for organic constituents.

(3) Reagents

3.1 Acetic acid, 0.5 N. Dilute 29.4 mL of concentrated acetic acid (ACS grade) to 1000 mL with reagent water.

3.2 Reagent water, Type IV (ASTM Specification D 1193). For organic parameters, the reagent water should be free of any organic substances to be analyzed (ASTM Type 1).

3.3 Nitric acid, 10% (v/v). Add 100 mL of concentrated nitric acid (ACS grade) to 900 mL of reagent water.

3.4 Nitrogen gas, pre-purified, scrubbed through a molecular sieve.

(4) Separation Procedure

If the sample contains a distinct liquid and a solid phase, separate it into its component phases using the following procedure:

4.1 Determine the dry weight of the solids in the sample at 60 °C, using a well homogenised sample. Use this weight to determine the amount of material to be filtered.

4.2 Assemble the filtration unit with a filter bed consisting of a 0.45 μm pore size membrane filter and a coarse glass fibre pre-filter upstream of the membrane filter (per manufacturer's instructions).

4.3 Select one or more blank filters from each batch of filters. Filter 50 mL portions of reagent water through each test filter and analyze the filtrate for the analytical parameters of interest. Note the volume required to reduce the blank values to acceptable levels.

4.4 Wash each filter used in the leach procedure with at least this predetermined volume of water. Filter under pressure until no water flows through the filtrate outlet.

4.5 Remove the moist filter bed from the filtration unit and determine its weight to the nearest ± 0.01 g.

4.6 Re-assemble the filtration unit, replacing the filter bed, as before.

4.7 Comminute the sample, with a mortar and pestle, to a size that will pass through the opening of the filtration unit (less than 9.5 mm).

4.8 Agitate the sample by hand and pour a representative aliquot of the solid and liquid phases into the opening of the filtration unit. Filter a sufficient amount of the sample to provide at least 60 g of dry solid material.

4.9 Pressurize the reservoir very slowly with nitrogen gas by means of the regulating valve on the nitrogen gas cylinder, until liquid begins to flow freely from the filtrate outlet.

4.10 Increase the pressure step-wise in increments of 0.5 kg/sq. cm to a maximum of 5 kg/sq. cm, as the flow diminishes. Continue filtration until the liquid flow ceases or the pressurizing gas begins to exit from the filtrate outlet of the filter unit.

4.11 De-pressurize the filtration unit slowly using the release valve on the filtration unit. Remove and weigh the solid material together with the filter bed to ± 0.01 g. Record the weight of the solid material.

4.12 Measure and record the volume and pH of the liquid phase. Store the liquid at 4 °C under nitrogen until required in Step 5.13.

4.13 Discard the solid portion, if the weight is less than 0.5% (w/v) of the aliquot taken. If not, proceed to Step 5.1.

Note: *For mixtures containing coarse grained solids, where separation can be performed without imposing a 5 kg/sq. cm differential pressure, a vacuum filtration unit with a filter bed as per Step 4.2 may be used. Vacuum filtration must not be used, if volatile organic compounds are to be analysed.*

(5) Extraction Procedure

5.1 Prepare a solid sample for extraction by crushing, cutting or grinding, to pass through a 9.5 mm mesh sieve. If the original sample contains both liquid and solid phases, use the solid material from Step 4.13. The structural integrity procedure, Step 6, should be used for monolithic wastes which are expected to maintain their structural integrity in a landfill, (e.g. some slags and treated solidified wastes).

Note: *Do not allow the solid waste material to dry prior to the extraction step.*

5.2 Determine the moisture content of the de-watered sample, by drying a suitable aliquot to constant weight at 60 °C in an oven. Discard the dried solid material.

5.3 Place the equivalent of 50 g dry weight of the de-watered undried material into a 1250 mL wide mouth cylindrical bottle. Use additional bottles, if a larger volume of leachate is required for the analysis.

5.4 Add 800 mL (less the moisture content of the sample in mL) of reagent water to the bottle.

5.5 Cap the bottle and agitate it in the rotary extractor for 15 minutes before pH measurement.

5.6 Measure and record the pH of the solution in the bottle using a pH meter, calibrated with buffers at pH 7.00 and pH 4.00. The solution should be stirred during the pH measurement.

5.7 Proceed to Step 5.10.1, if the pH is less than 5.2.

5.8 Add a sufficient volume of 0.5N acetic acid if the pH is greater than 5.2 to bring the pH to 5.0 ± 0.2.

Note: Maximum Amount of Acid: No more than 4 mL of 0.5N acetic acid per gram of dry weight of sample may be added during the entire procedure. If the pH is not lowered to 5.0 ± 0.2 with this amount, proceed with the extraction.

5.9 Cap the bottle and place it in the tumbling apparatus. Rotate the bottle and its contents at 10 rpm for 24 hours at room temperature (20 °C to 25 °C).

5.10 Monitor, and manually adjust the pH during the course of the extraction, if it is greater than 5.0 ± 0.2. The following procedure should be carefully followed:

5.10.1 Measure the pH of the solution after 1 hour, 3 hours and 6 hours from the starting time. If the pH is above 5.2, reduce it to pH 5.0 ± 0.2 by addition of 0.5N acetic acid. If the pH is below 5.0 ± 0.2, do not make any adjustments.

5.10.2 Adjust the volume of the solution to 1000 mL with reagent water, if the pH is below 5.0 ± 0.2 after 6 hours.

5.10.3 Measure and reduce the pH to 5.0 ± 0.2, if required, after 22 hours and continue the extraction for an additional 2 hours.

5.11 Add enough reagent water at the end of the extraction period so that the total volume of liquid is 1000 mL. Record the amount of acid added and the final pH of the solution.

5.12 Separate the material into its component liquid and solid phases as described under the Separation Procedure, Step 4. Discard the solid portion.

Note: It may be necessary to centrifuge the suspension at high speed before filtration, for leachates containing very fine grained particles.

5.13 Calculate the amount of free liquid from Step 4.12 corresponding to 50 g of the dry solid material. Add this amount to the leachate from Step 5.12.

Note: If the analysis is not performed immediately, store separate aliquots of the leachate at 4 ^{o}C, after adding appropriate preservatives for the analytical parameters of interest (See "A Guide to the Collection and Submission of Samples for Laboratory Analysis", Ontario Ministry of the Environment, July 1979).

5.14 Analyze the combined solutions from Step 5.13 for contaminants listed in Schedule 4, that are likely to be present.

5.15 Report concentrations of contaminants in the combined leachate and the free liquid solution as mg/L.

5.16 Carry a blank sample through the entire procedure, using dilute acetic acid at pH 5.0 ± 0.2.

6.0 Structural Integrity Procedure

This procedure may be required prior to extraction for some samples as indicated in Step 5.1. It may be omitted for wastes with known high structural integrity.

Procedure

6.1 Fill the sample holder with the material to be tested. If the sample of the waste is a large monolithic block, cut a portion from the block measuring 3.3 cm in diameter by 7.1 cm in length. For a treated waste (e.g. solidified waste) samples may be cast in a form with the above dimensions for the purposes of conducting this test. In such cases, the waste should be allowed to cure for 30 days prior to further testing.

6.2 Place the sample holder in the structural integrity tester, then raise the hammer to its maximum height and allow it to fall. Repeat this procedure 14 times.

6.3 Remove the material from the sample holder, and proceed to Step 5.2. If the sample has not disintegrated, it may be sectioned; alternatively use the entire sample (after weighing) and a sufficiently large bottle as the extraction vessel. The volume of reagent water to be initially added is 16 mL/g of dry sample weight. The maximum amount of 0.5N acetic acid to be added is 4 mL/g of dry sample weight. The final volume of the leachate should be 20 mL/g of dry sample weight.

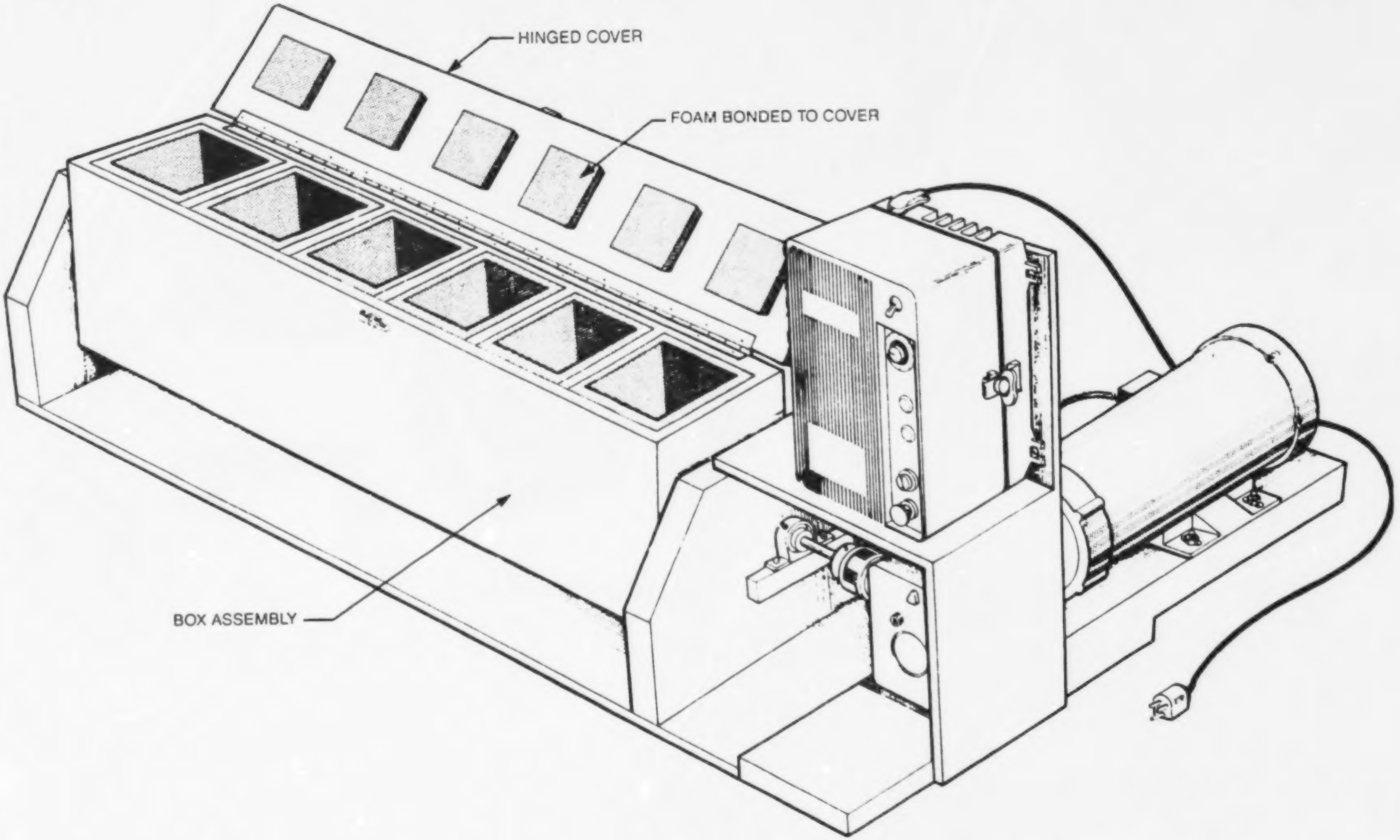

FIGURE 1
SOLID WASTE ROTARY EXTRACTOR

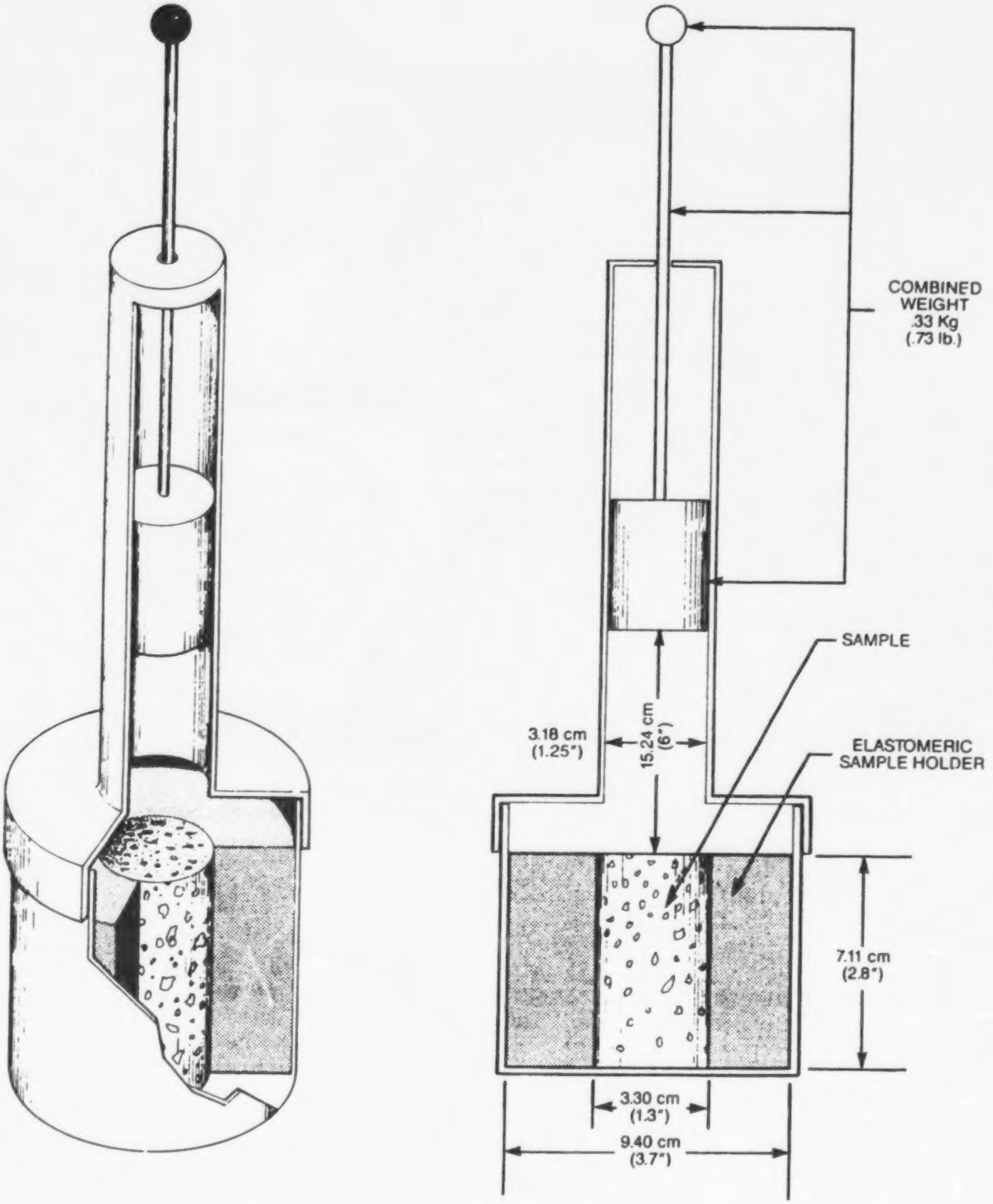

FIGURE 2
STRUCTURAL INTEGRITY TESTER

APPENDIX 4

LICENSED (APPROVED) HAZARDOUS WASTE TREATMENT AND DISPOSAL FACILITIES

APPENDIX 4

LICENSED (APPROVED) HAZARDOUS WASTE TREATMENT AND DISPOSAL FACILITIES

The following is a summary of licensed hazardous waste treatment and disposal facilities available across Canada:

BRITISH COLUMBIA

1.0 Existing Facilities:

None

2.0 Future Facilities Under Discussion or Development:

Genstar/IT Corporation proposal included:
- Physical/chemical treatment for special wastes
- Solidification of residues
- Secure landfill
- Use cement kiln for incineration of organic wastes

Genstar/IT Corporation withdrew the above proposal on July 30, 1984.

B.C. Government currently studying other options.
Proposed site: Undetermined.

ALBERTA

1.0 Existing Facilities:

1.1 Alberta Special Waste Management Corporation (ASWMC) (Crown Corporation)
- Charged with responsibility to oversee the development and coordination of a waste management system.

Operator:	Chem-Security Limited
Facilities:	Proposed facilities include: - two high temperature incinerators - physical/chemical treatment including solidification for inorganics - secure chemical landfill - deepwell disposal for treated liquids
Status:	Plant receiving certain waste. Physical/chemical treatment and incineration to be operational by April 1987.
Location:	Swan Hills, Alberta
Phone Number:	(403) 333-4197

ONTARIO

1.0 Existing Facilities:

1.1 Operator: Tricil (Sarnia) Limited

Location: RR#1 (Telfer Side Road)
Corunna, Ontario NON 1GO

Phone Number: (519) 864-1021

Facilities/Services:
- Waste transport
- Pre-treatment/fixation of liquid wastes with fly ash.
- High temperature and 2-chamber organic liquid waste incinerator - 99.99% destruction efficiency equipped with acid gas flue gas scrubber and fabric filters.
- Secure chemical landfill

2.0 Future Facilities Under Discussion or Development:

2.1 Ontario Waste Management Corporation (OWMC)
(Crown Corporation)

Facilities to include:
- High temperature rotary kiln incinerator with flue gas scrubbing
- Physical/chemical treatment plant with solidification capability
- Secure landfill

Proposed site: West Lincoln County, Ontario.

QUEBEC

1.0 Existing Facilities:

1.1 Operator: Tricil (Quebec) Inc.

Location: 6785 Route 132
Ville Ste. Catherine, Quebec JOL 1EO

Phone Number: (514) 632-6640

Facilities/Services:
- Waste transport
- Industrial in-plant maintenance and clean-up

1.2 Operator: Entreprises d'Incineration Industriel
Goodfellow Inc.

Location: 18a Rang, Ste. Marguerite
Ville Mercier, Quebec JOL 1KO

Phone Number: (514) 691-9610

Facilities/Services:
- High temperature incineration of organic wastes

1.3 Operator: Stablex Canada Incorporated

Location: 760 Boulevard Industriel, C.P. 420
Ste. Therese de Blainville, Que. J7E 4J7

Phone Number: (514) 430-9240

Facilities/Services:
- Chemical fixation of inorganic wastes
- Secure landfill

2.0 Future Facilities Under Discussion or Development:

2.1 SERDOQ (Societe d'Elimination et Recyclage des Dechets Organiques au Quebec) - private consortium

Plans call for $45 million high temperature rotary kiln with spray dryer/electrostatic precipitator and flue gas wet scrubber.

Proposed site: Undetermined.

APPENDIX 5

TRAINING AIDS

APPENDIX 5

TRAINING AIDS

The list of available courses and training aids such as films and cassettes on the subject of waste management is not prolific. The Canadian Petroleum Association has developed a videocassette on waste disposal for the upstream sector of the petroleum industry and it has received enthusiastic endorsement by both industry and government.

There are a variety of short courses offered by universities, trade associations and consultants aimed at industry professionals involved in groundwater monitoring and restoration of tainted aquifers. Some courses are offered in landfill design. The following training materials may be of value as supplements to in-house company training programs:

- The Petroleum Association for Conservation of the Canadian Environment (PACE) prepared a slide/tape presentation as an information vehicle for those interested in land treatment (landfarming) of wastes. This presentation is available from:

  PACE
  1202 - 275 Slater Street
  OTTAWA, Ontario K1P 5H9
  Telephone: (613) 236-9122

- The Canadian Petroleum Association has prepared a videocassette entitled "Waste Management". This is available by contacting:

  Canadian Petroleum Association
  1500, 633 - 6th Avenue S.W.
  CALGARY, Alberta T2P 2Y5
  Telephone: (403) 269-6721

- The American Petroleum Institute sponsored an audio-visual slide presentation as a training aid for landfarm operators. This training package was prepared and is distributed by:

  SCS Engineers
  4014 Long Beach Blvd.
  LONG BEACH, California 90807

- The Ontario Ministry of the Environment has prepared an audio-visual slide presentation regarding their Hazardous Waste Regulation 309. This material is available on a loan basis by contacting:

  Ministry of the Environment
  Waste Management Branch
  40 St. Clair Avenue West
  TORONTO, Ontario M4V 1P5
  Telephone: (416) 965-9668

- Environmental Resources Management Incorporated has developed a video seminar entitled "The New RCRA" which deals with the amendments to the U.S. Resource Conservation and Recovery Act. Although this presentation has a strong U.S. legal orientation, many of the principles contained in the video seminar package bear wide application to hazardous waste management in general. More information is available by contacting:

  Environmental Resources Management Inc.
  999 West Chester Pike
  WEST CHESTER, PA 19382
  Telephone: (215) 696-9110

In addition, courses are offered on the Transportation of Dangerous Goods Regulations since training is a requirement under law. These courses deal mainly with the classification of dangerous commodities, how to fill in the manifest form and correct labelling and placarding of the vehicle. Also, emergency response training in cases of transport accidental spills may be provided. The following is a list of training programs or materials offered in connection with TDGR:

- Emergency Planning Canada offers a 5 day seminar at the Federal Studies Centre in Arnprior, Ontario in conjunction with the Transport of Dangerous Goods Directorate. Further information may be obtained by contacting:

  Chief of Training
  Transport of Dangerous Goods Directorate
  Transport Canada
  Transport Canada Building
  Place de Ville
  OTTAWA, Ontario K1A 0N5
  Telephone: (613) 990-1149

- Manitoba Fire College offers a 2 day seminar on road transport of dangerous goods. Further information is available from the:

  Registrar
  Manitoba Fire College
  Box 935, 1610 Van Horne Avenue East
  BRANDON, Manitoba R7E 5Z9
  Telephone: (204) 727-8855

- Canadian Industrial Transportation League has developed seminar packages on the TDGR. For further information contact:

Canadian Industrial Transportation League
2360 Dundas Street West
TORONTO, Ontario M4P 4B2
Telephone: (416) 534-1101

or the

Canadian Trucking Association
130 Albert Street
OTTAWA, Ontario K1P 5G4
Telephone: (613) 236-9426

APPENDIX 6

INDUSTRY SURVEY PARTICIPANTS

APPENDIX 6

INDUSTRY SURVEY PARTICIPANTS

The following is a list of petroleum refineries and upgrader plants that participated in the PACE Waste Survey conducted in the last quarter of 1985. This survey provided the basic information necessary for the development of this manual:

BRITISH COLUMBIA	Petro-Canada Products Co.	Port Moody
	Husky Oil Operations Ltd.	Prince George
	Esso Petroleum Canada	Port Moody
	Shell Canada Limited	Burnaby
	Chevron Canada Ltd.	Burnaby
	Petro-Canada Products	Taylor
ALBERTA	Petro-Canada Products Co.	Edmonton
	Esso Petroleum Canada	Edmonton
	Shell Canada Limited	Scotford
	Texaco Canada Inc.	Edmonton
	Turbo Resources Ltd.	Balzac
	Syncrude Canada Ltd.	Fort McMurray
	Petro-Canada Products Co.	Moose Jaw
	Husky Oil Operations Ltd.	Lloydminster
ONTARIO	Esso Petroleum Canada	Sarnia
	Shell Canada Limited	Sarnia
	Petro-Canada Products	Oakville
	Petro-Canada Products	Clarkson
	Suncor	Sarnia
	Petrosar Limited	Sarnia
	Texaco Canada Inc.	Nanticoke
QUEBEC	Petro-Canada Products Co.	Montreal
	Shell Canada Limited	Montreal
	Ultramar Canada Inc.	St. Romauld
	Texaco Canada Inc.	Montreal
NOVA SCOTIA	Esso Petroleum Canada	Dartmouth
	Texaco Canada Inc.	Dartmouth

APPENDIX 7

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